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A new African species of the genus *Leiurus* Ehrenberg, 1828 from Mali (Scorpiones: Buthidae)

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Abstract

A new species of *Leiurus* Ehrenberg, 1828 is described on the basis of one male specimen collected in the mountain system of Adrar des Iforas, Cercle of Kidal, in Mali. The new species, *Leiurus tamajeq* sp. n. is most certainly associated to *Leiurus hoggarensis*, described from the Hoggar mountain system in Algeria, both species presenting an almost parapatric geographic distribution. Nevertheless, these closed related mountain systems have been isolated during past palaeoclimatic vicissitudes leading to possible differentiation processes. The two species can be distinguished by a number of morphological characters which clearly suggest that the new species population is distinct from the one found in the Hoggar mountain system. Differences are noticeable notably for morphometric values as well as the relative position of several trichobothria. As for *L. hoggarensis*, the new species seems to inhabit a more mesic zone when compared to the central compartment of the Saharan desert and, apparently, do not present characteristics of a psamophilic species and may be considered as a lithophilic species.

Keywords: scorpion, new species, *Leiurus tamajeq* sp. n., Buthidae, Mali, Adrar des Iforas.

Introduction

In some now old publications produced about 20 years ago, it was already emphasized that the number of new species of *Leiurus* present in the African continent

could be expected to increase rapidly (Lourenço *et al.*, 2002, 2006). The descriptions which really changed most conservative views about this group of scorpions were those of *Leiurus jordanensis* Lourenço, Modry & Amr, 2002 from Jordan, followed by *Leiurus savanicola* Lourenço, Qi & Cloudsley-Thompson, 2006 from Cameroon, representing the second confirmed species from Africa (Lourenço *et al.*, 2002, 2006).

This hypothesis of a rapid improvement in the number of species was confirmed in subsequent publications. A synopsis of these publications was proposed in Lourenço (2020a,b, 2021a) in which most historical aspects concerning the genus *Leiurus* were largely treated; consequently these will not be further discussed here.

This new improvement in the knowledge of the genus *Leiurus* was in part due to new collecting (e.g. Lourenço & El-Hennawy, 2021; Badry *et al.*, 2023) but in most cases due to the existence old specimens available in collections such as that of the Muséum in Paris, but not previously studied. In many, if not most cases these ‘old’ specimens were collected in regions which are no longer attainable in present days, mainly due to security reasons (Lourenço, 2020a,b, 2021a).

In this contribution, attention is given to one specimen collected more than 30 years ago in the Adrar des Iforas, North of Mali. Until that date it was assumed that only the classical species *Leiurus quinquestriatus* (Ehrenberg, 1828) was present in Africa, and in particular in zones closed to the Malian site such as the Hoggar mountain system in Algeria (Vachon, 1952). However, recently the status of the Hoggar population was clarified and a new species was described (Lourenço *et al.*, 2018). Due to a very limited number of field trips performed in this area, very few species have been reported from the Adrar des Iforas. More recently two species have been described from this area; the first in the genus *Orthochirus* and the second in the genus *Buthiscus* (Lourenço, 2021b; Ythier & Lourenço, 2023). This Malian location represents a totally new record for a *Leiurus* and the second one for this country (Lourenço, 2020b).

Material and Methods

The type specimen was originally conserved dry and posteriorly included in ethanol 70%. Illustrations and measurements were obtained using a Wild M5 stereo-microscope with a drawing tube and ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Cheliceral nomenclature follows Vachon (1963), while trichobothrial notations follow Vachon (1974, 1975). General morphological terminology mostly follows Hjelle (1990).

Taxonomic treatment

Family **Buthidae** C.L. Koch, 1837

Genus ***Leiurus*** Ehrenberg, 1828

Composition of the genus *Leiurus* in Africa, in order of description (Fig. 13):

- L. quinquestriatus* (Ehrenberg, 1828) (Egypt, Sudan)
- L. savanicola* Lourenço, Qi & Cloudsley-Thompson, 2006 (Cameroon)
- L. somalicus* Lourenço & Rossi, 2016 (Somalia)
- L. hoggarensis* Lourenço, Kourim & Sadine, 2018 (Algeria)
- L. ater* Lourenço, 2019 (Chad)
- L. gubanensis* Kovařík & Lowe, 2020 (Somalia)
- L. dekeyseri* Lourenço, 2020 (Mauritania)
- L. saharicus* Lourenço, 2020 (Mali)
- L. nigerianus* Lourenço, 2021 (Nigeria)

L. aegyptiacus Lourenço & El-Hennawy, 2021 (Egypt)
L. sinai Badry, Saleh, Lourenço & Ythier, 2023 (Egypt)
Leiurus tamajeq sp. n. (Mali)

Leiurus tamajeq sp. n. (Figs. 1-10)

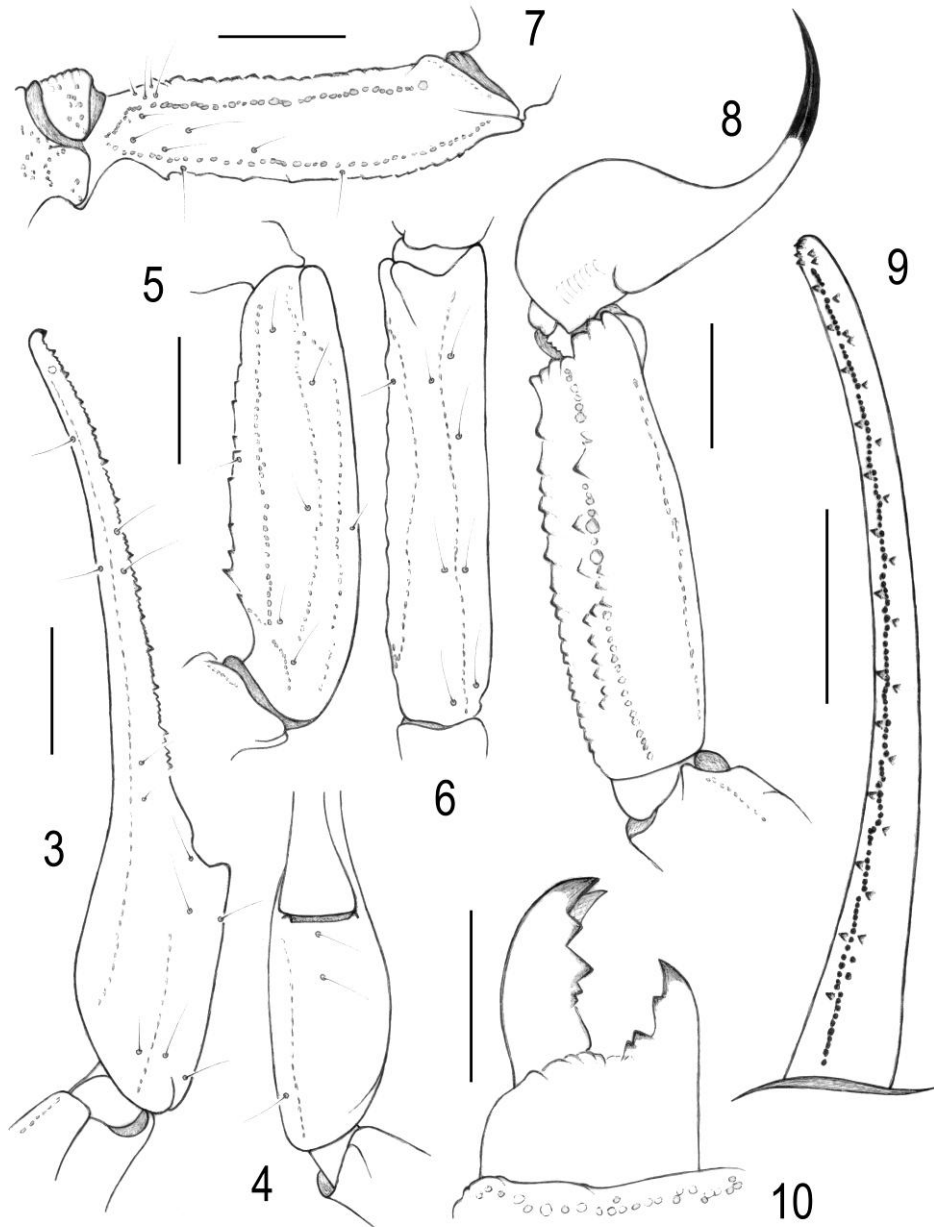
Type material: Mali, Adrar des Iforas (Ifoghas), Cercle de Kidal, 680 m. IX/1988 (Ehya Ag Sidiyene leg.) (Figs. 11-12). Male holotype deposited in the Muséum national d'Histoire naturelle, Paris.

Etymology: specific name is placed in apposition to the generic name and refers to the Tamajeq people (Tuareg in Berber language), autochthones to the region where the new species was collected.



Figs. 1-2. *Leiurus tamajeq* sp. n., male holotype, habitus. 1. dorsal aspect. 2. ventral aspect. (Scale bar: 2 cm).

Diagnosis: Scorpion of large size when compared with the other species of the genus, having a total length of 84.1 mm for male (see Table I). Ground colour yellow to pale yellow with the body and pedipalps almost totally pale yellow. Male carapace with a slightly brownish zone which covers the ocular tubercle; metasomal segment V only slightly infusate; other metasomal segments pale yellow. Ocular tubercle moderately prominent. Pectines with 34-34 teeth for male holotype. Median carinae on sternites III-IV moderately marked; sternite VII with mediate intercarinal surface presenting a thin granulation. Pedipalp fixed and movable fingers with 12-13 rows of granules on male holotype.



Figs. 3-10. *Leiurus tamajeq* sp. n., male holotype. 3-7. Trichobothrial pattern. 3-4. Chela, dorso-external (3) and ventral (4) aspects. 5-6. Patella, external (5) and dorsal (6) aspects. 7. Femur, dorsal aspect. 8. Metasomal segment V and telson, lateral aspect. 9. Fixed finger showing the rows of granules. 10. Chelicera, dorsal aspect. (Scale bars: 3 mm except chelicera 2 mm).

Description based on male holotype (morphometric measurements in Table I):

Colouration. Ground colour yellow to pale-yellow; body and pedipalps almost totally pale yellow; legs pale yellow. Carapace pale yellow with a brownish spot which covers the ocular tubercle. Mesosoma tergites without infuscations. Metasoma pale yellow on segments I to IV; segment V slightly infuscate. Vesicle yellow with some reddish tonalities on lateral sides; aculeus yellow at the base and dark red at its extremity. Venter yellow to pale yellow without spots. Chelicerae yellow without any reticulated spots; teeth dark red. Pedipalps yellow to pale yellow overall except for the rows of granules on chela fingers which are dark red. Legs yellow to pale yellow.

Morphology. Prosoma: anterior margin of carapace with a weak concavity. Carapace carinae moderately to strongly developed; central median and posterior median carinae moderate to strong; anterior median carinae strong; central lateral moderate to strong; posterior median carinae moderate to strong, terminating distally in a small spinoid process that extends very slightly beyond the posterior margin of the carapace. Intercarinal spaces with a few irregular granules, and the reminder of the surface almost smooth, in particular laterally and distally. Median ocular tubercle in a central position and moderately prominent; median eyes large in size and separated by about two ocular diameters. Four pairs of lateral eyes; the fourth pair is vestigial. Mesosomal tergites I-II pentacarinata; III-VI tricarinate. All carinae strong, granular; each carina terminating distally in a spinoid process that extends slightly beyond the posterior margin of the tergite. Median carinae on I moderate to strong; on II-VI strong, crenulate. Tergite VII pentacarinata, with lateral pairs of carinae strong and fused; median carinae present on the 2/3 of the surface, strongly marked. Intercarinal spaces moderately to strongly granular. Lateral carinae absent from sternite III; moderate to strong on sternites IV-VI; strong, crenulate on VII; median carinae on sternites III-IV moderate. Pectines long; pectinal tooth count 34-34 on male holotype. Metasomal segments I-II with ten carinae, moderately crenulate; lateral inframedian carinae on I moderate; on II present on the posterior 1/4; III and IV with eight carinae. Dorsal and dorsolateral carinae moderate, without any enlarged denticles distally. All the other carinae moderate to weak on segments I-IV. Segment V with five carinae; ventromedian carinae with several slightly spinoid granules distally; anal arch with three lobes, not spinoid. Dorsal furrows of all segments weakly developed and smooth; intercarinal spaces globally smooth, with only a few large granules on the ventral surface of segment V. Telson smooth; subaculear tubercle absent; aculeus as long as vesicle. Chelicerae with two reduced denticles at the base of the movable finger (Vachon, 1963). Pedipalps: trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β (beta) configuration (Vachon, 1975). Femur pentacarinata; all carinae moderately crenulate. Patella with seven carinae; all carinae moderately to weakly crenulate; dorsointernal carinae with 2-3 spinoid granules distally. Chelae slender, with elongated fingers; all carinae weakly marked, almost vestigial. Dentate margins of fixed and movable fingers composed of 12-13 almost linear rows of granules. Legs: ventral aspect of tarsi with short spiniform setae more or less arranged in two rows. Tibial spurs present on legs III and IV, moderately to strongly marked. Pedal spurs present on all legs, strongly marked.

Relationships

The new species clearly shows affinities with *Leiurus hoggarensis* Lourenço, Kourim & Sadine, 2018 described from the Hoggar mountain system in the South of Algeria; both species presenting an almost parapatric geographical distribution.

Table I. Morphometric values (in mm) and selected morphometric ratios of the male holotype and female paratype of *Leiurus hoggarensis* and the male holotype of *Leiurus tamajeq* sp. n. (L: length, W: width, D: depth).

| | <i>Leiurus hoggarensis</i> | | <i>Leiurus tamajeq</i> sp. n. |
|-------------------------------------|----------------------------|--------|-------------------------------|
| | Male | Female | Male |
| Total length | 77.7 | 94.6 | 84.1 |
| Carapace: | | | |
| - length | 8.4 | 10.5 | 8.6 |
| - anterior width | 5.8 | 7.2 | 6.2 |
| - posterior width | 9.5 | 12.5 | 10.2 |
| Mesosoma length | 17.8 | 20.7 | 19.6 |
| Metasomal segment I: | | | |
| - length | 6.7 | 8.2 | 7.1 |
| - width | 5.6 | 6.2 | 5.5 |
| Metasomal segment II: | | | |
| - length | 8.2 | 9.8 | 9.1 |
| - width | 5.2 | 5.3 | 4.8 |
| Metasomal segment III: | | | |
| - length | 8.3 | 10.3 | 9.0 |
| - width | 4.7 | 4.9 | 4.7 |
| Metasomal segment IV: | | | |
| - length | 9.1 | 11.4 | 9.9 |
| - width | 4.3 | 4.6 | 4.2 |
| Metasomal segment V: | | | |
| - length | 10.5 | 12.5 | 11.6 |
| - width | 4.0 | 4.6 | 3.8 |
| - depth | 3.6 | 3.9 | 3.5 |
| Telson length | 8.7 | 11.2 | 9.2 |
| Vesicle: | | | |
| - width | 3.4 | 4.2 | 3.5 |
| - depth | 3.2 | 3.8 | 3.2 |
| Pedipalp: | | | |
| - femur length | 8.9 | 11.1 | 10.3 |
| - femur width | 2.2 | 2.7 | 2.5 |
| - patella length | 9.8 | 12.3 | 11.4 |
| - patella width | 2.8 | 3.2 | 3.0 |
| - chela length | 15.8 | 19.9 | 18.5 |
| - chela width | 2.5 | 3.2 | 2.6 |
| - chela depth | 2.6 | 3.3 | 2.9 |
| - movable finger length | 11.2 | 14.4 | 13.5 |
| Morphometric ratios: | | | |
| - metasomal segment I L/W | 1.20 | 1.32 | 1.29 |
| - metasomal segment V L/W | 2.63 | 2.72 | 3.05 |
| - metasomal segment V L/D | 2.92 | 3.21 | 3.31 |
| - telson L/W | 2.56 | 2.67 | 2.63 |
| - telson L/D | 2.72 | 2.95 | 2.89 |
| - pedipalp chela L/W | 6.32 | 6.22 | 7.12 |
| - pedipalp chela L/D | 6.08 | 6.03 | 6.38 |
| - pedipalp chela L/movable finger L | 1.41 | 1.38 | 1.37 |

Nevertheless the two species can be distinguished by a number of characters: (i) distinct morphometric values for male specimens of similar size-class (see Table 1), (ii) tergites

more strongly granular in the new species, (iii) only metasomal segments I and II present 10 carinae in the new species (I-III with 10 carinae in *H. hoggarensis*), (iv) finally the trichobothrial positions in the new species are marked by several differences: on femur, **d₂** is reduced, and **e₁** is proximal in relation to **d₄** (distal in *H. hoggarensis*); on patella, **i** is more distal and **esb_{1,2}** are at the same level (**esb₁** proximal to **esb₁** in *H. hoggarensis*); on chela fixed finger, **et** and **est** are very closed to each other (well separated in *H. hoggarensis*) and **db** and **est** are almost at the same level (**db** well distal to **est** in *H. hoggarensis*, almost equidistant from **et** and **est**).

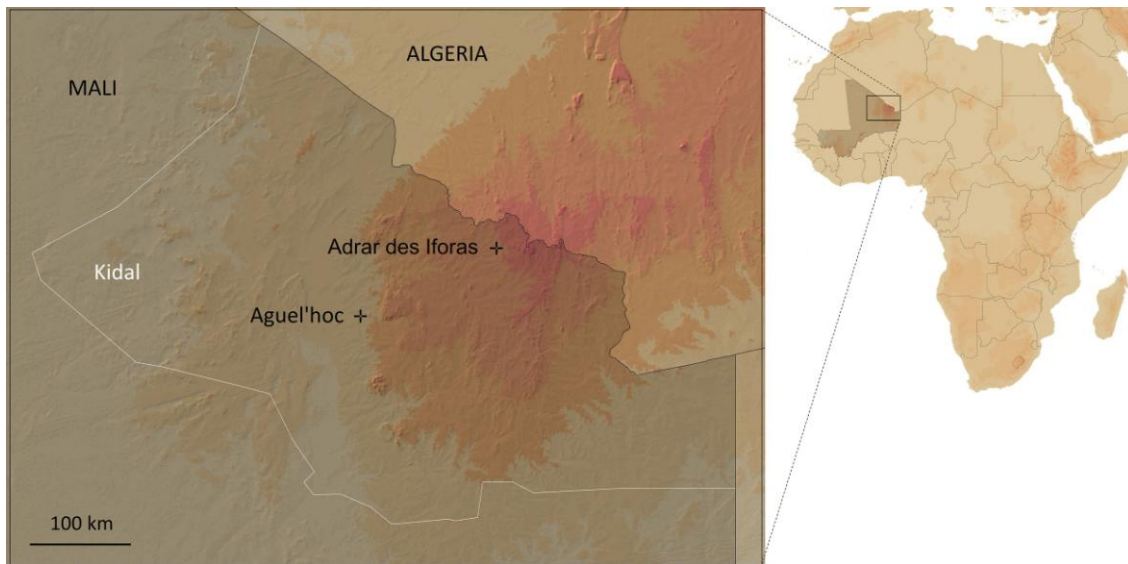


Fig. 11. Map of Mali, showing the general relief of the region and the emplacement of the Adrar des Iforas.

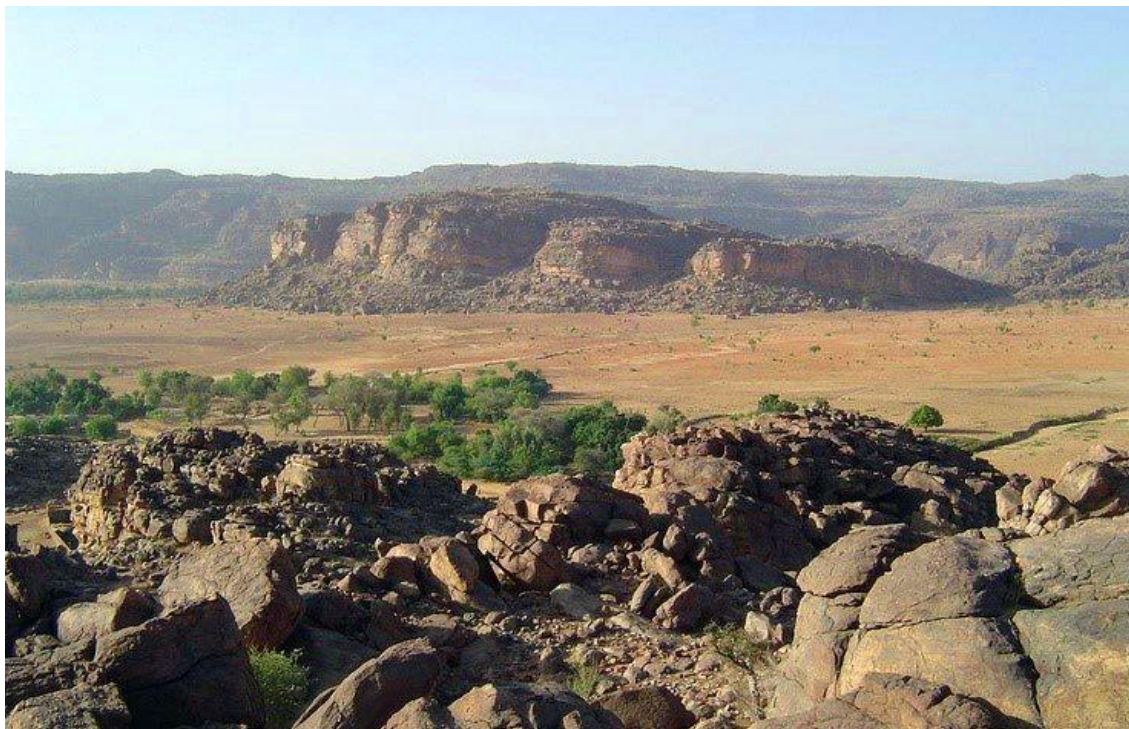


Fig. 12. Adrar des Iforas, Mali (© maliweb.net).

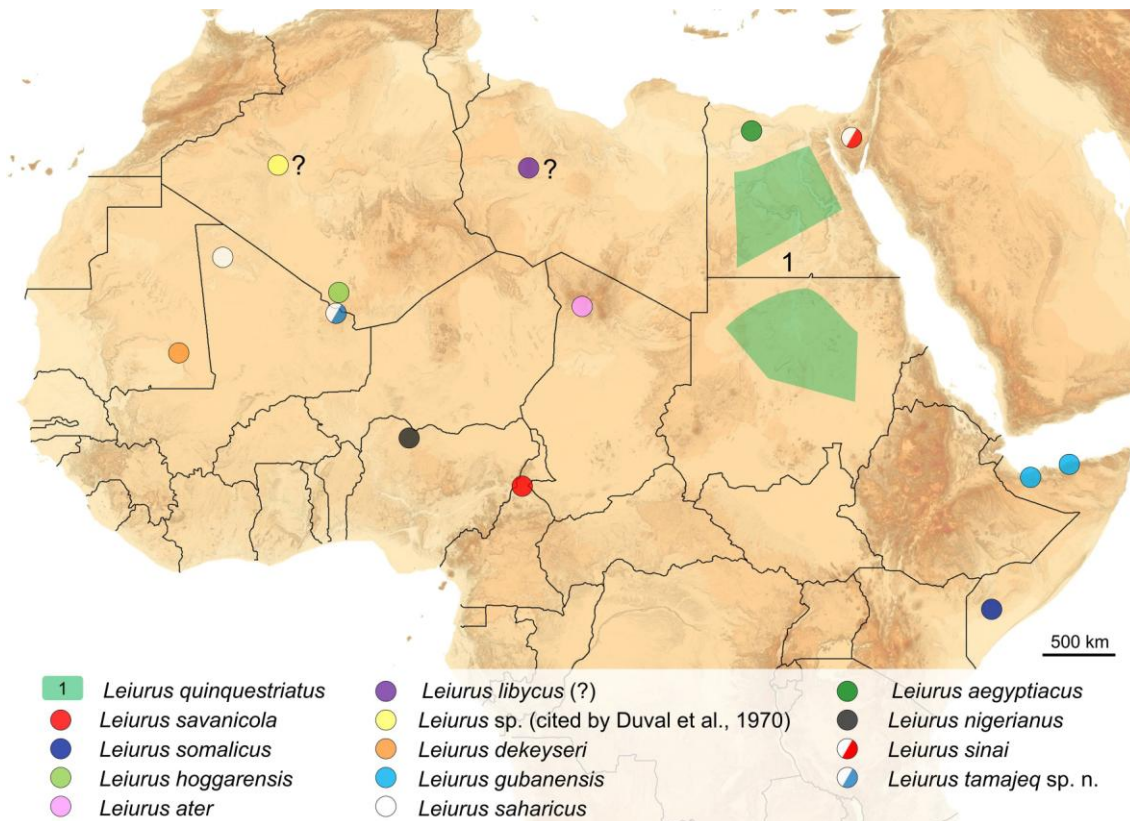


Fig. 13. Map of the North portion of Africa showing the distribution of the known *Leirus* species.

Some biogeographic comments

As already suggested in previous publications (Qi & Lourenço, 2007; Lourenço & Duhem, 2009; Lourenço *et al.*, 2012), the present composition of the Saharan fauna is, in fact, the heritage of ancient faunas present in North Africa since the beginning of or, at least, middle Cenozoic times. North Africa has experienced numerous palaeo-climatological vicissitudes in the last few million years, some even in more or less recent quaternary periods.

Even if the Sahara Desert is not extremely old as other desert formations in the world, it is possible to postulate that some extremely arid areas have always existed as patchy desert enclaves, even when the general climate of North Africa enjoyed more mesic conditions. In these arid and desert regions, a specialized scorpion fauna would have evolved in response to aridity. These ‘ancient lineages’ adapted to arid conditions, undoubtedly correspond to several extant groups including the genus *Leirus*; a number of these groups being typically psammophilic. It is important to emphasise that these lineages have been present in North Africa for at least a few million years (see Qi & Lourenço, 2007 for references). Contrarily, other lineages less well adapted to aridity and, previously only present in more mesic environments, have regressed markedly in their distribution with the expansion of the desert and experienced a form of negative selection. To the best, these populations have been reduced to very limited and patchy zones of distribution, sometimes with remarkable disjunctions in their patterns of distribution.

The patterns observed today in the distribution of North African scorpions can be summarised as follows: 1) a core Saharan region which was defined by Vachon (1952) as

the ‘central compartment’ in which only the groups best adapted to xeric conditions are distributed; 2) a perisaharian zone of distribution which forms a ring around the most arid core region of the Sahara. In this zone can be observed some groups which require more mesic environmental conditions; 3) finally, as already suggested by Vachon (1952), some populations may have their distribution limited to refugia which in many cases correspond to the Saharan Massifs.

The Sahara mountain ranges have attracted the attention of naturalist since the middle of the 20th Century. Some early observations on scorpions were reported for example by Vachon (1950, 1958). These publications, however, were far from satisfactory because the majority of the authors simply associated local species to others already known from other areas of the Sahara. Only more recently new studies started to demonstrate that many of these local populations actually correspond to undescribed and endemic species.

Among these mountain systems some were frequently treated such as the Adrar, Hoggar, Tassili N’Ajjjer and Aïr (Vachon, 1940, 1950, 1958) and more recently the Tibesti, Ennedi and Kapka (Lourenço *et al.*, 2012). Contrarily, very few results are available for the Adrar des Iforas, basically only some recent reports such as those of Lourenço (2021b) and Ythier & Lourenço (2023).

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A new species of jumping spider genus *Harmochirus* Simon, 1886 from Bangladesh (Araneae: Salticidae: Harmochirinae)

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Abstract

A new jumping spider species, *Harmochirus maijdiensis* sp. n. of the family Salticidae is described from the southern coastal area of Bangladesh. Brief generic diagnosis, and distribution are provided together with the description of the species.

Keywords: Jumping spider, Araneae, Salticidae, *Harmochirus*, Bangladesh.

Introduction

Jumping spiders (family Salticidae) are common predatory arachnids in the crop-fields, gardens and forests. They are distributed throughout the world and the family contains 6666 species belonging to 680 genera in the world (World Spider Catalog, 2024). *Harmochirus* Simon, 1886 is a widely distributed genus of jumping spiders placed under the clade Simonida Maddison, 2015 of the Tribe Plexippini and Subtribe Harmochirina Simon, 1903 under the Subfamily Harmochirinae Simon, 1886 are commonly found in the gardens and forests of Bangladesh. The genus was first erected by Simon in 1886 with the type-species *Ballus brachiatus* Thorell, 1877. It comprises at present 11 species in the world (World Spider Catalog, 2024) of which only 3 species are known in the fauna of Bangladesh (Okuma *et al.*, 1993; Biswas, 2009, 2016; Biswas & Raychaudhuri, 2019).

Material and Methods

The specimens in this study were collected from shrubs of gardens of Maijdi, near Noakhali Government College campus, Noakhali District by hand collecting and

vegetation beating method. All the collected specimens were preserved in 70% ethanol. The preserved specimens are currently in the collection of the Department of Zoology, Khulna Government Womens' College, Khulna-9000, Bangladesh [DOZ, KGWC] and will be deposited in the department of Zoology, University of Dhaka, Bangladesh [DOZ, DU], in due course of time.

All the necessary body-parts of the specimens (viz. – chelicerae, maxillae, labium, pedipalps etc.) are dissected out and illustrated under stereozoom binocular microscope. Male palp is dissected out and cleared in 10% KOH for 3-5 minutes following Levi (1965) and Tikader (1987). Leg measurements are given as in the following sequence: femur, patella, tibia, metatarsus, tarsus, and total length. All measurements are in millimetres.

Taxonomy

Family **Salticidae** Blackwall, 1841
Subfamily **Harmochirinae** Simon, 1886
Genus ***Harmochirus*** Simon 1886

Diagnosis: Members of the genus *Harmochirus* are very small to small, dark-brown spiders, covered with small spiny hairs. Cephalothorax darker and larger than nearly rounded abdomen. Cephalothorax on the level of posterior lateral eyes (PLE) wider. Eyes usually brown or pearly-white, highly elevated; anterior median eyes (AME) more larger than anterior laterals (ALE), each of which ringed with black bands; posterior lateral eyes (PLE) situated nearer to or on the margin of carapace (Fig. 1a). Chelicerae brown, strong, with few teeth (1-3) on the margin. Maxillae and labium brown, elongate or pot-like, with scopulae. Legs usually short, 1st leg much elongate with swollen or enlarged tibia, covered with long, feathery bristles; metatarsi and tarsi clothed with brown, strong spines. Abdomen broad, rounded or oval, clothed with hairs and spines; male with more distinct scutum; lateral spinnerets something elongate.

Biological note: Spiders of this genus are usually found in gardens and forests among the grasses and leaves of plants. They do not spin any web, but the females during the breeding season make a typical nest in the leaves or loose barks of trees in which they lay their eggs and remain there till the maturity of the newly hatched spiderlings. Adult members wander the leaves of plants in search of prey and when they find prey, immediately jump in and capture the prey.

Distribution: Asia, Australia, and Africa.

***Harmochirus maijdiensis* sp. n.** (Figs. 1a-1h)

Material examined: Holotype: 1 male. Paratype: 1 male; both collected from the same locality.

Type locality: Bangladesh: Maijdi, District Noakhali, 18.VII.2007, and 27.II.2008, Coll. V. Biswas. Types are at present in the collection of the Department of Zoology, Khulna Govt. Women's' College and will be deposited to the Museum of the Department of Zoology, University of Dhaka, Bangladesh.

Description of the male (Fig. 1a): Body very small, blackish brown, legs and abdomen dark brown. Total body length 5.30 mm. Carapace 3.00 mm long and 1.97 mm wide; abdomen 2.30 mm long and 1.82 mm wide.

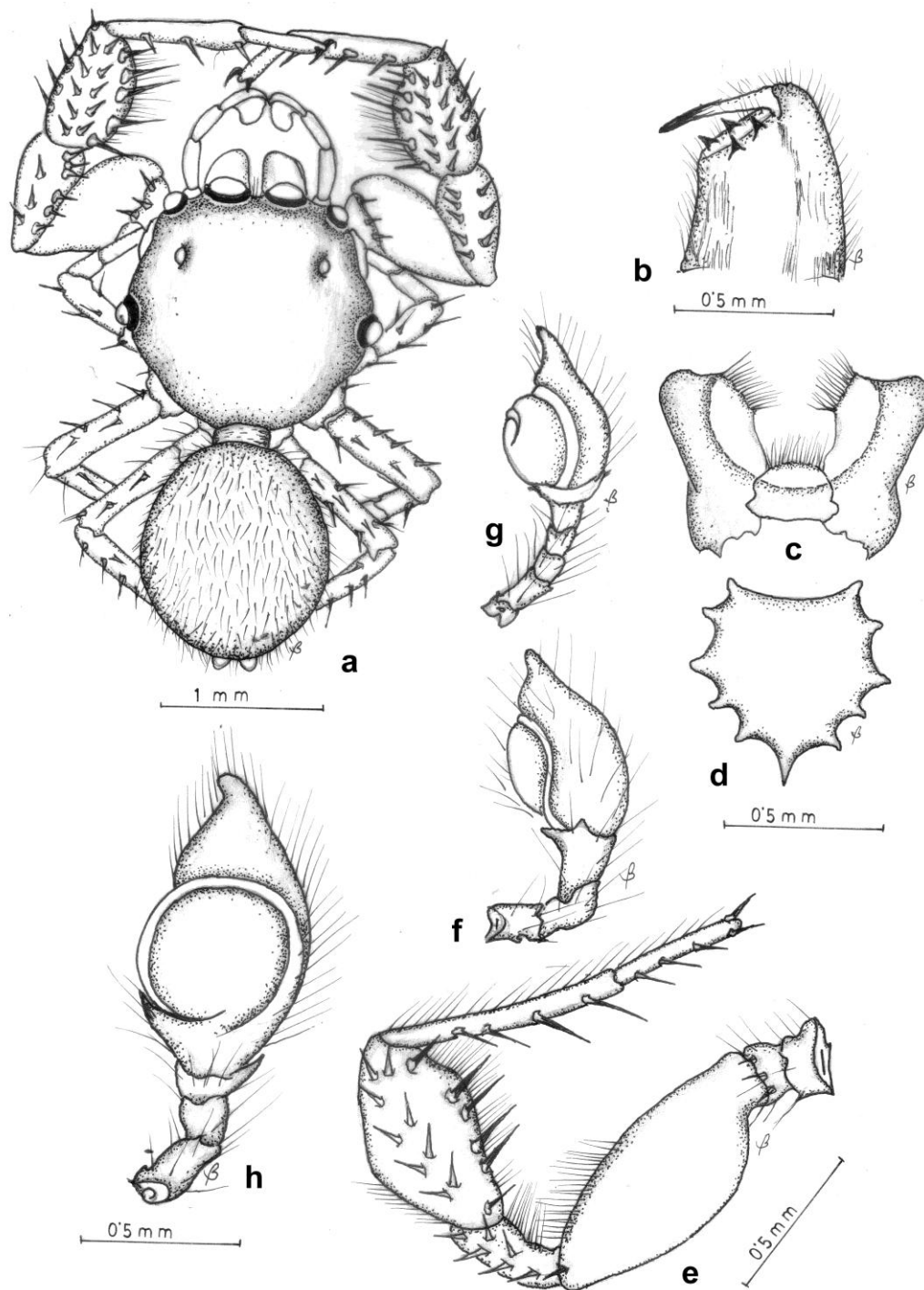


Fig. 1. *Harmochirus maijdiensis* sp. n. a. Habitus, dorsal view. b. Chelicera. c. Maxillae and labium. d. Sternum. e. First leg. f-h. Male palp. f. lateral view. g. retro-lateral view. h. ventral view.

Cephalothorax: Broad, blackish brown, wider medially, anteriorly broad and posteriorly narrowing; cephalic region little elevated, clothed with small brown spines and pubescence. Eyes pearly white, dissimilar; anterior row of eyes faintly recurved; anterior medians nearly 3 times larger than the antero-laterals; 2nd row of eyes brown, minute, placed little far from the anterior row; posterior row of eyes large, straight, placed marginally; ocular trapezium nearly square shaped, wider posteriorly (Fig. 1a). Chelicerae

broad, brown, strong, longer than wide, broad basally, both pro- and retro-margins with two teeth (Fig. 1b). Maxillae brown, longer than wide, anteriorly scopulate (Fig. 1c). Labium brown, small, pot-like, anteriorly scopulate (Fig. 1c). Sternum light brown, heart-shaped, anteriorly concave and posteriorly pointed (Fig. 1d). Legs moderately long and robust; leg I very large, femur and tibia swollen, tibia fringed with many sharp, strong spines; tarsi with two claws (Fig. 1e). Leg formula 1342. Measurements (in mm) of leg segments are shown in Table (1). Male palp as in figs. (1f-h).

Table 1. Measurements of leg segments of *Harmochirus maijdiensis* sp. n.

| Leg | Femur | Patella | Tibia | Metatarsus | Tarsus | Total |
|-----|-------|---------|-------|------------|--------|-------|
| I | 1.60 | 0.40 | 1.20 | 1.30 | 0.90 | 5.40 |
| II | 0.90 | 0.20 | 0.70 | 0.70 | 0.50 | 3.00 |
| III | 1.50 | 0.30 | 1.10 | 1.00 | 0.80 | 4.70 |
| IV | 1.30 | 0.30 | 1.00 | 0.90 | 0.70 | 4.20 |

Abdomen: Oval, dark brown, postero-medially wide, clothed with brown, erect hairs; ventrally pale brown, spinnerets small, blunt.

Female: Unknown.

Etymology: The species is named after the name of the type-locality “Maijdi”, District Noakhali, Bangladesh.

Diagnosis: The present species *H. maijdiensis* sp. n. appears close to *H. brachiatus* (Thorell, 1877) and *H. luculentus* Simon, 1886 (Tikader, 1976; Logunov, 2001) but it stands distinct in having the following characters:

(1) Posterior lateral eyes situated on the lateral margin forming a tubercle in both *H. luculentus* and *H. maijdiensis* sp. n. but the appearance and structure are quite different. (2) Cephalothorax is wider than in *H. brachiatus* and *H. luculentus*. (3) Cheliceral structure and dentition different. (4) Maxillae, labium and structure of sternum different. (5) Structure of leg-I and its spination are different. (6) Structure of palpal organ (cymbium, paracymbium etc.) differs with that of *H. brachiatus* and its other Indian congeners and species known from elsewhere (Tikader, 1976; Paik, 1987; Prószyński, 1987; Davies & Żabka, 1989; Okuma *et al.*, 1993; Barrion & Litsinger, 1995; Logunov *et al.*, 1997; Logunov, 2001; Xiao & Wang, 2005; Peng, 2020).

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***Harmochirus maijdiensis* Biswas, 2024**

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New species of genus *Peucetia* Thorell, 1869 (Araneae: Oxyopidae) from India

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Abstract

A female of new species of genus *Peucetia* Thorell, 1869 from family Oxyopidae with description of *Peucetia chhaparajirvin* sp. n. from Tal Chhapar Wildlife Sanctuary, Churu, Rajasthan, India. The new species is first time described, diagnosed and illustrated.

Keywords: Oxyopidae, *Peucetia*, description, illustration, Rajasthan, India.

Introduction

Peucetia Thorell, 1869 commonly known as green lynx spider, has 47 known species from worldwide in which only 21 species have been documented from India. Species of genus *Peucetia* documented from India are: *Peucetia akwadaensis* Patel, 1978, *P. ananthakrishnani* Murugesan, Mathew, Sudhikumar, Sunish, Biju & Sebastian, 2006, *P. ashae* Gajbe & Gajbe, 1999, *P. biharensis* Gajbe, 1999, *P. betlaensis* Saha & Raychaudhuri, 2007, *P. choprai* Tikader, 1965, *P. elegans* (Blackwall, 1864), *P. gauntleta* Saha & Raychaudhuri, 2004, *P. graminea* Pocock, 1900, *P. harishankarensis* Biswas, 1975, *P. jabalpurensis* Gajbe & Gajbe, 1999, *P. ketani* Gajbe, 1992, *P. latikae* Tikader, 1970, *P. pawani* Gajbe, 1999, *P. phantasma* Ahmed, Satam, Khalap & Mohan, 2015, *P. punjabensis* Gajbe, 1999, *P. rajani* Gajbe, 1999, *P. rangathanani* Biswas & Roy, 2005, *P. viridana* (Stoliczka, 1869), *P. viveki* Gajbe, 1999, and *P. yogeshi* Gajbe, 1999 (World Spider Catalog, 2024).

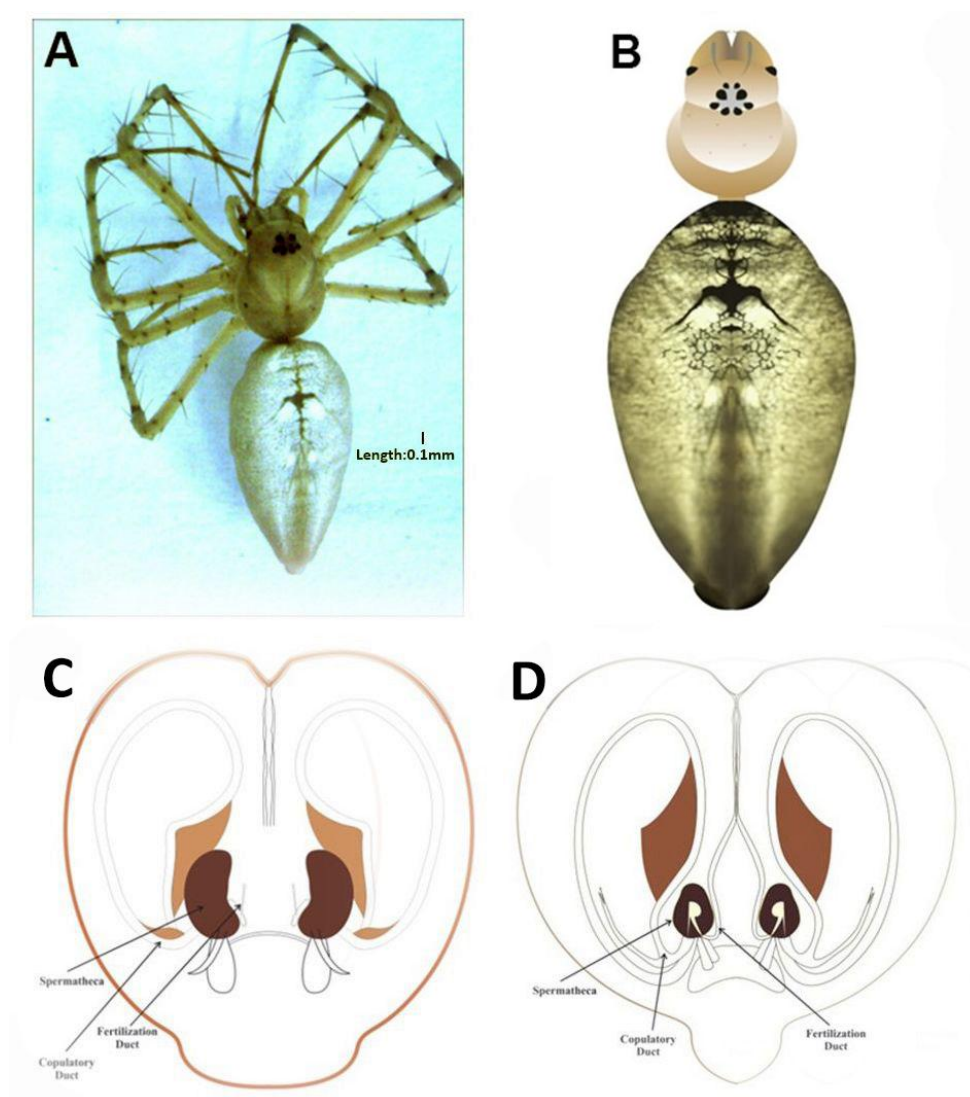


Fig. 1. *Peucetia chhaparajirvin* sp. n. Holotype female. A-B. Habitus, dorsal view. C-D. Epigyne. C. dorsal view. D. ventral view.

The representative characters of the genus are: presence of eyes on the edge of cephalic region, clypeus (with or without clypeal lines), and chelicerae (devoid of teeth) positioned vertically to cephalic region, legs long with conspicuous spines, and abdomen narrowing posteriorly with terminal spinnerets. Their green hue aids to blend within surroundings and ambush prey, while their long legs allow them to move quickly and agile.

The present paper illustrates and describes a new species of genus *Peucetia* named *Peucetia chhaparajirvin* sp. n., first time reported from Tal Chhapar Wildlife Sanctuary, Churu, Rajasthan, India.

Material and Methods

The studied specimen was collected from Tal Chhapar Wildlife sanctuary (27°47'53"N, 74°26'06"E / 27.798141°N, 74.434937°E), Churu, Rajasthan, by beating the leaves of *Vachellia nilotica* tree. Collected sample was preserved in 70% alcohol and deposited in Lab No. 16, Department of Zoology, University of Rajasthan, Jaipur.

Morphological observations and photography were taken by microscope Olympus SZ61 and S Image software, respectively. Female genitalia was dissected out and digested with 10% aqueous KOH for further analysis under microscope at Spider Research Laboratory (SR Lab), JD Patil Sangludkar Mahavidyalaya, Daryapur.

Abbreviations used in text and table are: ALE = anterior lateral eye, AME = anterior median eye, (AME-AME = distance between anterior median eyes), d = dorsal, pl = prolateral, PLE = posterior lateral eye, PME = posterior median eye, rl = retrolateral, v = ventral. All measurements are in millimetres.

Taxonomy

Family **Oxyopidae** Thorell, 1869

Genus **Peucetia** Thorell, 1869

***Peucetia chhaparajnrvin* sp. n.** (Fig. 1)

Type Material: Holotype female from Tal Chhapar Wildlife Sanctuary, district Churu, Rajasthan, India (27°48'37"N, 74°26'09"E) August 2022, collected by Nirmala Kumari and Babita.

Etymology: Name of species is given on area where this species discovered Tal Chhapar Rajasthan (Research area) and the initials of discoverer Nirmala Kumari & Dr. Vinod Kumari.

Diagnosis: *Peucetia chhaparajnrvin* sp. n. resembles *Peucetia akwadaensis* Patel, 1978 but differ as follows: 1. Clypeus with two discontinuous clypeal lines in *P. akwadaensis* but *P. chhaparajnrvin* has two continuous clypeal lines from anterior median eyes to near the base of chelicerae. 2. Abdominal stripes and bands are significantly different. 3. The interior of genitalia and epigyne patterns are also entirely distinct.

Description (Total length 11.2):

Cephalothorax: of light brownish colour with numerous dark spots, 3.6 long, 2.9 wide, cephalic region high and concave anteriorly, ocular region brownish with grey mat of hair, posterior row of eyes slightly procurved and equal in size, anterior row strongly recurved, anterior median eyes smallest and lateral eyes largest among all, diameter of AME = 0.2, ALE = 0.5, PME = 0.4, PLE = 0.4. Eye to eye distance AME-AME = 0.2, ALE-ALE = 0.4, PME-PME = 0.2, PLE-PLE = 0.8, ALE-PLE = 0.3. Clypeus long, with two clypeal lines from anterior median eyes up to the base of chelicerae. Chelicerae with two long spines and some numerous hair, short curved fang at its apex. Sternum heart shaped, pointed behind, projected in between the coxae of legs IV, covered with fine hair and black spines. Maxillae olive green, longer than wide, almost double the size of labium, covered with spines and hair, scopulae at anterior margin. Leg formula: 1243, leg measurements are given in table (1), tarsal claws three, yellowish brown in colour, long and strong, covered with hair and evident long spines, spination pattern as in table (2), all femora and coxae without roundish spots.

Abdomen: Abdomen length 7.6, longer than wide, light green, posteriorly pointed, widest in middle, dorsal and ventral side covered silvery patches, $\frac{3}{4}$ mid dorsal part longitudinally decorated, $\frac{1}{4}$ posterior part with a furrow, posteriorly skin with multiple overlapped fold, ventral side the same as dorsal side, mid-ventrally whitish longitudinal stripe starting from epigastric furrow to the base of spinnerets (Fig. 1). Spinnerets six, light brown in colour distinctly converging each other, anterior spinnerets have spigots, median spinnerets smallest, posterior-lateral spinnerets largest in all. Internal genitalia

with two globular spermathecae, copulatory duct and fertilization duct are conspicuous (Fig. 1C-D).

Table 1. Measurements of legs of female *Peucetia chhaparajirvin* sp. n.

| Leg | Femur | Patella | Tibia | Metatarsus | Tarsus | Total |
|-----|-------|---------|-------|------------|--------|-------|
| I | 5.0 | 1.2 | 5.0 | 5.1 | 2.4 | 19.0 |
| II | 4.7 | 1.2 | 4.2 | 4.3 | 1.9 | 16.6 |
| III | 3.7 | 1.1 | 3.0 | 3.0 | 1.4 | 12.5 |
| IV | 4.1 | 1.1 | 3.3 | 3.8 | 1.5 | 14.1 |

Table 2. Spination patterns of legs of female *Peucetia chhaparajirvin* sp. n.

| Leg | Femur | Patella | Tibia | Metatarsus |
|-----|--------------|---------|------------------|--------------|
| I | d3, pl3, rl3 | d2 | d2, pl1, rl1, v4 | pl5, rl3 |
| II | d3, pl3,rl4 | d2 | d2,pl2, rl2, v4 | pl6, rl4 |
| III | d3, pl3, rl3 | d2 | d2, pl2, rl1, v4 | pl4, rl3 |
| IV | d3, pl3, rl1 | d2 | d1, pl2, rl2, v3 | d1, pl4, rl3 |

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Review of the distribution of *Androctonus amoreuxi* (Audouin, 1825) (Scorpiones: Buthidae) in Morocco

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Abstract

This is a brief synoptic review of *Androctonus amoreuxi* (Audouin, 1825) in Morocco. A summary of its morphological description is provided. Five new localities of this species in Morocco from Errachidia (1 station) and Tinghir (4 stations) provinces are reported, substantiated by photos of live specimens observed therein. Based on previous ecological study of this species, with its observation records on iNaturalist and geographical references from satellite images, we suggest that *A. amoreuxi* may spread more widely in the extreme southern Morocco, a Saharan area with vast arid regions of suitable ecological conditions for its dispersal, into the north of Mauritania. An updated distribution map of this species in Morocco is provided as per these new records and previous studies. Finally, after comparing its morphology with its congeners, we urge a more systematic review of this species giving the ambiguity of its true identity and the likelihood of being a species-complex comprising three cryptic lineages.

Keywords: scorpion, *Androctonus amoreuxi*, distribution, Morocco.

Introduction

Androctonus amoreuxi (Audouin, 1825), Amoreux's man-killer scorpion, is one of the most distinctive, large-sized and yellow-coloured species within the genus *Androctonus* Ehrenberg, 1828, where a majority of congeners are typically dark in colour (dark brown to black). This species is particularly characterized by its elongated and

slender metasoma that distinguishes it from most congeners, giving rise to its common name, “the North African long-tailed scorpion”. Ecologically, it is colloquially considered as a desert scorpion, giving that its presence is primarily associated with sandy substrates (Touloun *et al.*, 2014b: 18). However, subsequent studies revealed that this species also dwells upon loam to sand-clay loam without specific tendency, suggesting a high ecological adaptation ability (e.g., El Hidan *et al.*, 2017: fig. 3). In any case, *A. amoreuxi* shows its preference towards the Saharan bioclimatic floor with an altitude ranging from 400 to 800 m a.s.l. (El Hidan *et al.*, 2017: table 2; total range 0-1600 m a.s.l., as per El Hidan *et al.*, 2017: table 1). This large arachnid is a powerful nocturnal predator with the capacity of preying upon small reptiles. A notable instance of its predatory prowess is manifested in a predation event involving a juvenile *Acanthodactylus* lizard in western Algeria (Sadine & El Bouhissi, 2021).

A. amoreuxi was originally described as *Scorpio amoreuxii* (an obsolete spelling for its specific epithet) from Egypt based on a female holotype which is probably lost (Fet & Lowe, 2000: 65); subsequent studies confirmed its wider distribution beyond Egypt (see below for discussions). Within Morocco, former studies showed that this species was predominantly found in Tafilalet region in the north, along the Anti-Atlas mountain ranges, to the Draa Valley in the southeast (Touloun *et al.*, 2014b: 18), and also occurring in other regions. As illustrated by Kamel *et al.* (2022: fig. 1; however most data of this species were disputable), *A. amoreuxi* has been previously recorded from Alnif (Tinghir Province) and Aoufous (Errachidia Province). In this study, we further present five new localities of this species from these two provinces as a formal confirmation, with an updated map of the species’ distribution within Morocco and comments on its distribution unlimited to the country. Finally, we discuss the taxonomic status of this species in association with other congeners.

Material and Methods

Material. The five specimens collected by the first author of this study were all from Tinghir Province (1♂ from Achdad, 1♀ and 1♂ from Taghzoute N’Ait Atta, and 1♀ from Tarya), with the exception of one female collected from Ksar Lbour in Errachidia Province. The specimens were preserved in 96% ethanol and examined microscopically by the first author in the Functional Ecology and Environmental Engineering Laboratory at the Faculty of Science and Technics in Fez, Morocco. The fifth new locality was from another area of Tinghir Province, Ait Zeggane (near Alnif town). More than 10 live specimens have been observed so far from that region by Mr. Abdesslam Souiri, who provided us with the coordinates of the station (Table 1) and photos of some of the specimens he took (Fig. 12; not examined).

Methods. Records of *A. amoreuxi* in Morocco were based on the personal observations of the first author, observations by other people (supported by photos and coordinates), and previous documentations in papers (see below for comments). Particularly, several records on the website iNaturalist that did not fall within the formally reported distribution area of this species were adopted (Table 2). SimpleMappr (Shorthouse, 2010) was used for illustrating exact known records of this species in Morocco by the second author (Fig. 1). Google Earth (satellite images) and ArcGIS were used to construct a map of potential spatial coverage (by tracking the desert area) of this species by the first author (Fig. 2). The potential distribution area illustrated in this study only represents a crude measure as it does not take into account the precise climatic and geographic information. A more accurate approach can be applying the Maximum Entropy method.

Abbreviations. DSC = pedipalp chela denticle subrow count, PTC = pectinal tooth count.
Specimens Depository. MM = personal collection of Mohamed Mousaid, Fez, Morocco.

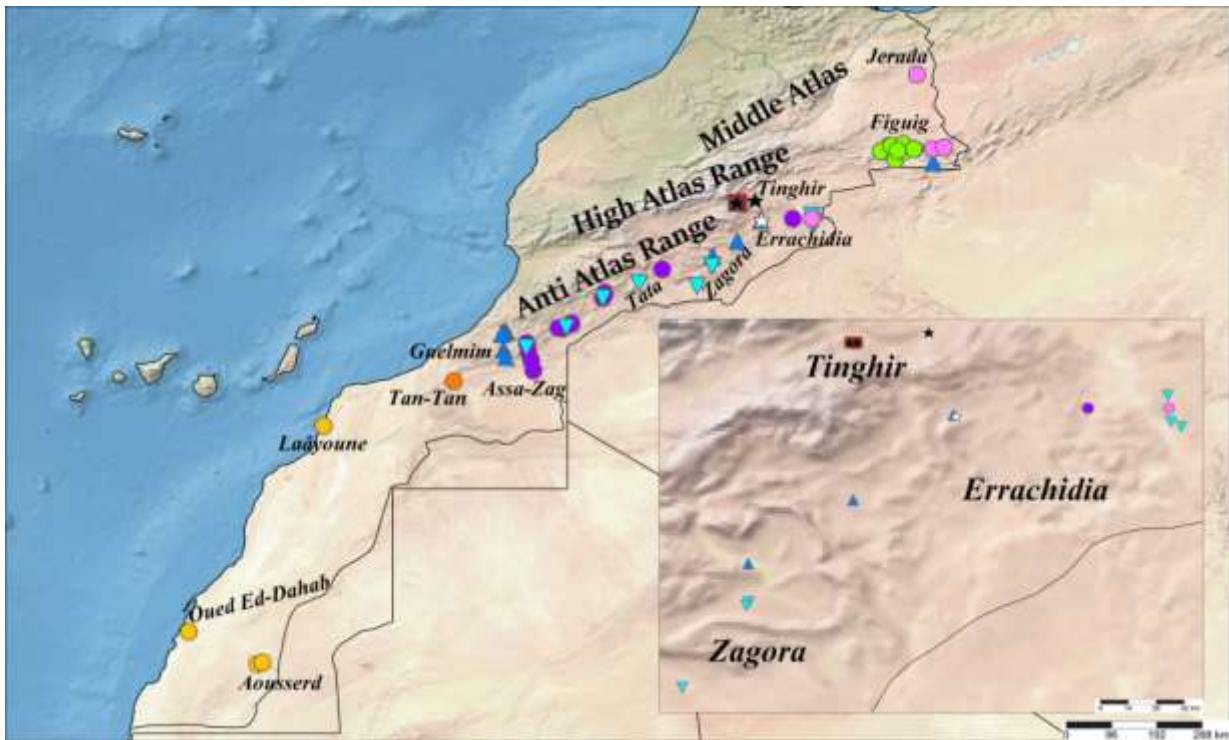


Fig. 1. Map showing part of the known records (not exhaustive) of *Androctonus amoreuxi* (Audouin, 1825) in Morocco with provinces labeled. ★: records of examined specimens in this study by the first author; ☆: record of specimens by Mr. Abdesslam Souiri; ■: records of unexamined specimens in this study by the first author (Figs. 3-7, 13-18); ▲: records of selected iNaturalist observations in this study (Table 2); ▼: records of unselected iNaturalist observations in this study; ●: records in Moroccan Sahara based on the provided coordinates in Touloun *et al.* (2014b: 18; 2016: table 1); ●: records of sympatric *A. amoreuxi* with *Buthacus stockmanni* in Kovařík *et al.* (2016: 6), one record is covered by a record of AM1 clade in Assa-Zag; ●: records taken from Ythier & François (2023: 2); ●: records of AM1 clade identified by Coelho *et al.* (2014: table 1); ●: records of AM2 clade identified by Coelho *et al.* (2014: table 1).

Systematics

Family **Buthidae** C.L. Koch, 1837
 Genus *Androctonus* Ehrenberg, 1828
Androctonus amoreuxi (Audouin, 1825)
 (Figs. 3-18; Tables 1-2)

[<http://zoobank.org/?lsid=urn:lsid:zoobank.org:act:479A74AF-465C-45D0-B5C6-BBE1C4E44960>]

Table 1. Records of observations of *Androctonus amoreuxi* (Audouin, 1825) by the first author and Mr. Abdesslam Souiri who observed specimens that were not examined.

| Locality | Latitude | Longitude | Observer | Date |
|--|---------------------------------|--------------------------------|---------------------|-------------------------------|
| Ksar Lbour (Errachidia Province) | 31°29'29.7132"N (31.4915870) | 5°06'12.5568"W (-5.1034884) | Mousaid Mohamed | 3 rd VII 2023 |
| Achdad (Tinghir Province) | 31°26'36.6792"N (31.4435216) | 5°26'08.7972"W (-5.4357772) | Mousaid Mohamed | 20 th VIII 2023 |
| Ait Zeggane (Tinghir Province) | 31°06'21.2"N (31.105878) | 4°58'53.0"W (-4.981380) | Souiri Abdesslam | 24 th VIII 2021 |
| Taghzoute N'Ait Atta (Tinghir Province) | 31°26'49.884"N (31.4471895) | 5°25'36.12"W (-5.4267003) | Mousaid Mohamed | 4 th VII 2022 |
| Tarya (Tinghir Province) | 31°26'39.2028"N (31.4442233) | 5°27'35.5428"W (-5.4598735) | Mousaid Mohamed | 19 th VII 2023 |

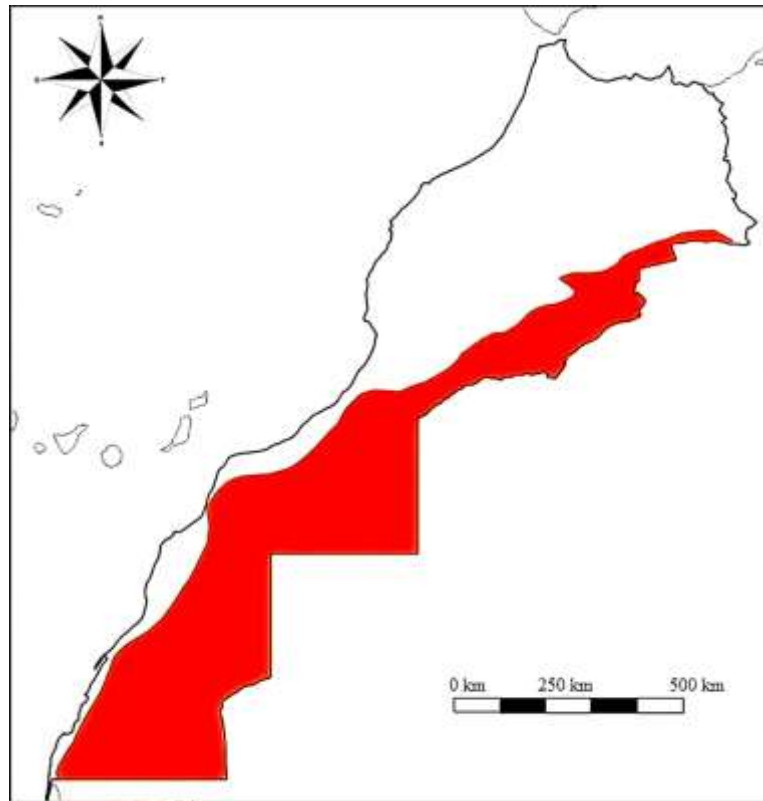


Fig. 2. Map showing the potential distribution area of *Androctonus amoreuxi* (Audouin, 1825) in Morocco.

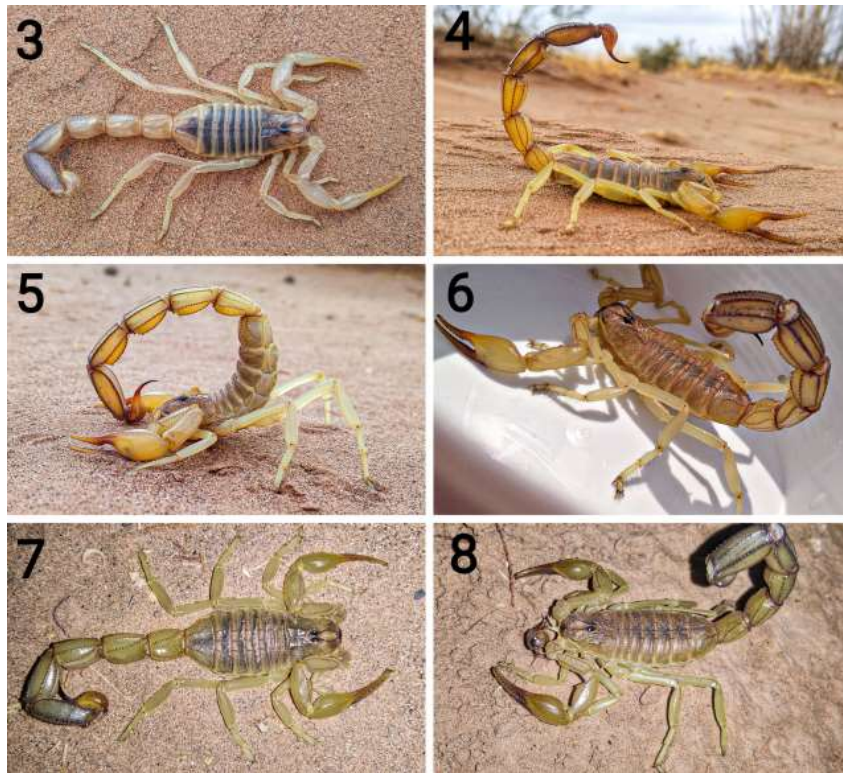
Material Examined (MM). Morocco, *Errachidia Province*, Ksar Lbour, 31°29'29.7132"N, 5°06'12.5568"W (31.4915870°N, -5.1034884°W), 3rd July 2023, 1♀, leg. M. Mousaid; *Tinghir Province*, Douar Achtat (Achdad), 31°26'36.6792"N, 5°26'08.7972"W (31.4435216°N, -5.4357772°W), 20th August 2023, 1♂, leg. M. Mohamed; *Tinghir Province*, Taghzoute N'Ait Atta, 31°26'49.884"N, 5°25'36.12"W (31.4471895°N, -5.4267003°W), 14th July 2022, 1♂ 1♀, leg. M. Mousaid; *Tinghir Province*, Tarya Village, 31°26'39.2028"N, 5°27'35.5428"W (31.4442233°N, -5.4598735°W), 19th July 2023, 1♀, leg. M. Mousaid.

Table 2. Records of adopted observations of *Androctonus amoreuxi* (Audouin, 1825) by the observers on iNaturalist. The iNaturalist ID is the observation ID at the end of the address: <https://www.inaturalist.org/observations/>.

| Locality | Latitude | Longitude | Observer | Date | iNaturalist ID |
|-------------------------------------|-----------------------------|----------------------------|------------------|------------------|----------------|
| Jboub Zoulai (Figuig Province) | 32°13'00.4"N (32.216781) | 1°42'22.1"W (-1.706149) | Olivier Fortune | 23rd V 1996 | 144446234 |
| Aouinet Lahna (Guelmim Province) | 28°30'15.6"N (28.504336) | 9°51'19.4"W (-9.855376) | Laurent Barthe | 28th V 2017 | 147320646 |
| El Borj (Guelmim Province) | 28°38'56.5"N (28.649023) | 9°53'53.1"W (-9.898089) | Julien Rouard | 16th XI 2022 | 142465487 |
| Fask (Guelmim Province) | 28°59'00.4"N (28.983451) | 9°50'54.1"W (-9.848369) | Vojtěch Víta | 29th IV 2017 | 145416888 |
| Fask (Guelmim Province) | 28°59'15.8"N (28.987722) | 9°51'17.5"W (-9.854862) | Justin Philbois | 8th VI 2023 | 168177373 |
| Tightmert (Guelmim Province) | 28°56'31.9"N (28.942197) | 9°56'17.3"W (-9.938126) | Jandetka | 13th IX 2018 | 64538051 |
| Tightmert (Guelmim Province) | 28°49'58.6"N (28.972030) | 9°55'29.2"W (-9.909766) | Julien Rouard | XI 2022 | 142481082 |
| Ait Zeggane (Tinghir Province) | 31°06'40.3"N (31.111192) | 4°59'35.5"W (-4.993183) | Al Zawahifmag | 22nd VII 2019 | 87203450 |
| Ait Oulhyane (Zagora Province) | 30°43'11.0"N (30.719722) | 5°26'36.8"W (-5.443553) | Alex Frood | 4th VII 2022 | 124866298 |
| Tafraoute (Zagora Province) | 30°25'37.5"N (30.42709) | 5°54'56.2"W (-5.915602) | Bouazza Abdellah | 8th IV 2019 | 109212317 |

Description. *A. amoreuxi* is a large species that can reach 110 mm in total length (Lourenço, 2005: 157). It is particularly polymorphic in terms of its colouration. Typically, a general pattern is followed by all observed individuals: basic colouration yellowish (mesosoma somewhat darker due to the underlying viscera), with fingers of pedipalp chela reddish yellow to reddish brown and metasomal carinae somewhat darkened at least on segment V. However, the colouration may differ intraspecifically in several specific areas: (1) overall colouration vary from light yellow to brownish yellow (rarely; cf. iNaturalist: obs. ID = 145498618), with juveniles often being greyish yellow to greyish brown; (2) metasoma may be progressively infusate, and particularly darkened on the lateral and ventral surfaces of metasoma V; (3) pedipalp chelae may be darkened; (4) pedipalp patella and femur, as well as those of the legs may be somewhat infusate (mainly in juveniles); (5) the two triangular granular areas located interior to the lateral ocelli at the anterior margin of carapace may be darkened; (6) vesicle of telson may vary from light yellow to dark brown (cf. Touloun *et al.*, 2014b: fig. 1A). The overall profile of its body is rather slender, with elongated legs comprising highly hirsute tarsi (especially the basitarsi) and pedal spur specialized for locomotion on loose sands. Carapace and tergites are finely granulated, with tergites I-VI bearing three longitudinal carinae and VII being pentacarinata. Carinae on pedipalps and metasoma segments are formed by small, rounded, discrete granules without prominent spinoid granules. The ventrolateral carinae of metasoma V are replaced by sharper denticles, increasing in size posteriorly. Telson consists of a moderate-sized vesicle and a relatively long aculeus. Sexual dimorphism in adults (besides PTC) is represented as males being more slender (especially the mesosoma), with a more prominent notch at the base of the fixed finger of

the pedipalp, forming a conspicuous gap when closed. Despite the fact that there have been many specimens identified as *A. amoreuxi*, a critical redescription based on its topotypes is urged to clarify the strict diagnostic characters of this species (see below). Our report here is only based on the current consensus regarding this species.



Figs. 3-8. Live specimens of *Androctonus amoreuxi* (Audouin, 1825) observed in the wildness of Morocco by the first author, uploaded on iNaturalist (coordinates and observation IDs in parentheses). 3-7. from Tinghir Province. 3. A juvenile from Tarya Village (31°26'53.2"N, 5°27'22.6"W; 133072909). 4-7. from Taghzoute N'Ait Atta. 4. An adult female (31°26'47.5"N, 5°25'36.6"W; 185356622). 5. An adult male (31°26'47.3"N, 5°25'38.7"W; 133063626). 6. An adult male (31°26'47.6"N, 5°25'38.6"W; 126466576). 7. An adult female (31°26'48.8"N, 5°25'36.5"W; 185315589). 8. An adult female, examined in this study, from Ksar Lbour, Errachidia Province (31°29'29.7132"N, 5°6'12.5568"W; 186260987).

Ecology. The observed specimens from Tinghir province are all from an area characterized by a predominantly sandy substrate with a dominance of the *Tamarix* sp. and *Phoenix dactylifera* L., 1753 formation. Unlike other species that share the same region, such as *Hottentotta gentili* (Pallary, 1924) and *Androctonus liouvillei* (Pallary, 1924) which mainly colonize palm oases (personal observation of the first author), *A. amoreuxi* is more adapted to anthropic environments. This species is also sympatric with a variety of its congeners across its distribution area, including *A. liouvillei* in the east, to *A. bourdoni* Vachon, 1948 in the southwest, and to *A. gonneti* Vachon, 1948 in the extreme southwest Saharan region. In their study of the ecology of *Buthacus stockmanni* Kovařík, Lowe & Šťáhlavský, 2016, the authors point out that this species shares its habitat with a variety of other scorpions in its type locality (north of Zag, Assa-Zag Province), including *A. amoreuxi*. In addition, *A. amoreuxi* was commonly found in a sandy flat area with scarce rocks and sparse shrubs, north of Msied, in Tan-Tan Province (Kovařík *et al.*, 2016: 12). Scorpions are nocturnal animals, and they are easy to

encounter or to find using the ultraviolet light. After sunset, *A. amoreuxi* emerge from their burrows, in front of which they stay for an extended period to inspect the external environment. Predation behaviour takes place when they experience the arrival of hunger. Scorpions were found most active during midnight, roaming freely in search of food, especially in open places. Oued Toudgha is a vast open sandy environment dominated by trees of *Tamarix* sp. Scorpions were occasionally found lying motionlessly on the ground (Fig. 7), among dry grasses or the fallen branches of *Tamarix* sp.

Comments on localities. Tinghir is considered an important province, as it provides a corridor to the southeast, characterized by an arid climate. In recent years, it has experienced a major drought which has radically changed the vegetation structure of the region and significantly contributed to the degradation of the palm groves. Currently, five scorpion species are reported from Tinghir: *A. amoreuxi*, *A. liouvillei*, *H. gentili*, *Buthus* cf. *boumalenii* Touloun & Boumezzough, 2011, and *Scorpio* sp. As for the western Moroccan Sahara, it is a vast arid desert area that covers a large proportion of the total area of the country. In general, the arachnological research in this region has been poorly conducted. Touloun *et al.* (2014b, 2016) are the only studies that focused on the distribution of these scorpion fauna in the farthest area of this region, near the border between Morocco and Mauritania.

Discussion

Former distribution records of *A. amoreuxi*

A. amoreuxi was considered to occupy an extensive area from Africa to Asia (Fet & Lowe, 2000: 65; Dupré *et al.*, 2023). However, most of those records appear to be rather suspicious (Lourenço, 2005: 157), particularly the following countries in Asia: Afghanistan, Iran, Pakistan, and Uzbekistan. Records from Afghanistan and Pakistan might align with several subsequently described species (e.g., *A. afghanus* Lourenço & Qi, 2006, *A. cholistanus* Kovařík & Ahmed, 2013 and *A. finitimus* (Pocock, 1897)). The record from Iran is most likely the misidentified *A. baluchicus* (Pocock, 1900) [now *A. sistanus* by Barahoei *et al.* (2022)] which by then was placed as a subspecies of *A. amoreuxi*. Report of this species from Uzbekistan could represent *Olivierus* sp. in reality. Its occurrences in several African countries (in parentheses) might correspond to several distinct species: *A. burkinensis* Ythier, 2021 (Burkina Faso; suggested by the author of description), *A. dekeyseri* Lourenço, 2005 (Senegal; also from Mauritania), *A. pallidus* Lourenço, Duhem & Cloudsley-Thompson, 2012 (Chad), and *A. simonettai* Rossi, 2015 (Ethiopia; suggested by the author of description). Additionally, its records from Sudan and Niger (Fet & Lowe, 2000: 67) warrant further confirmation. Conclusively, the most reliable coverage area of *A. amoreuxi* is currently limited within the following countries: Algeria (plentiful recent records, including Ait Hammou *et al.*, 2023: fig. 5), Egypt (including Sinai Peninsula), Israel (possibly Jordan and northern Saudi Arabia as well; for the subspecies *A. a. levyi* Fet, 1997), Libya, Mauritania (north region), and Morocco (including western Moroccan Sahara). However, it is still likely that the records from those regions may comprise more than one species (*A. amoreuxi*), given the phylogenetic findings by Coelho *et al.* (2014) (see below). It is worth noting that a specimen (MNHN-RS-RS2026) under the name “*Androctonus amoreuxi* Audouin & Savigny, 1825” was allegedly considered the holotype of *A. amoreuxi* from Djanet, Algeria, by the National Museum of Natural History, Paris, France. However, previous publications (including Audouin’s original description) suggested that this species was based on the material from Egypt.



Figs. 9-12. Live specimens of *Androctonus amoreuxi* (Audouin, 1825) observed in the wildness of Morocco by others: 9. Near Merdane and Mfis, Errachidia Province (31°03'30.5"N, 3°58'02.4"W), ©Max Prins. 10-11. El Borj Desert (28°38'56.5"N, 9°53'53.1"W) and near Tighmert (28°49'58.6"N, 9°55'29.2"W), Guelmim Province, © Julien Rouard. 12. Ait Zeggane, Tinghir Province (31°06'21.2"N, 4°58'53.0"W), © Abdesslam Souiri.

Within Morocco, it was previously believed that the distribution of *A. amoreuxi* was restricted to the far southeastern of the country, bordering Algeria where it does not exceed Zagora towards the north (Vachon, 1952: fig. 228; Lourenço *et al.*, 2009: fig. 12; Ythier & Lourenço, 2022: fig. 20). Recent records confirmed its presence in the further north of Morocco, with one being somewhere near Bouârfâ (750-1500 m a.s.l.) from Figuig Province. In their study of the scorpion fauna of the eastern region of Morocco, Ythier & François (2023: 2, fig. 1) collected numerous specimens of *A. amoreuxi* from different sites in this region, which is mainly deserted and featured by an ideal arid climate for this species. Several new localities of *A. amoreuxi* were confirmed by different observers in southeast of Errachidia Province, somewhere near Merzouga (Figs. 1, 9-11). Coelho *et al.* (2014: fig. 1) have also reported this species from those two regions. Doubts are cast upon the illustrated extensive distribution of *A. amoreuxi* populations in the northern Morocco by Kamel *et al.* (2022: fig. 1), which was highly discordant with previous knowledge pertaining to its dispersal ability within this country. Their map illustrated plentiful localities of *A. amoreuxi* to the west of the High-Atlas mountain range. This is neither congruent with the known ecological preferences of this species or the records by most researchers. Their records of other congeners were also highly questionable. Therefore, we chose to ignore those dubious reports. Conversely, Lourenço (2008: fig. 11) had previously suggested the potential distribution of *A. amoreuxi* in the Moroccan Sahara, the extreme south of Morocco, but did not list explicit

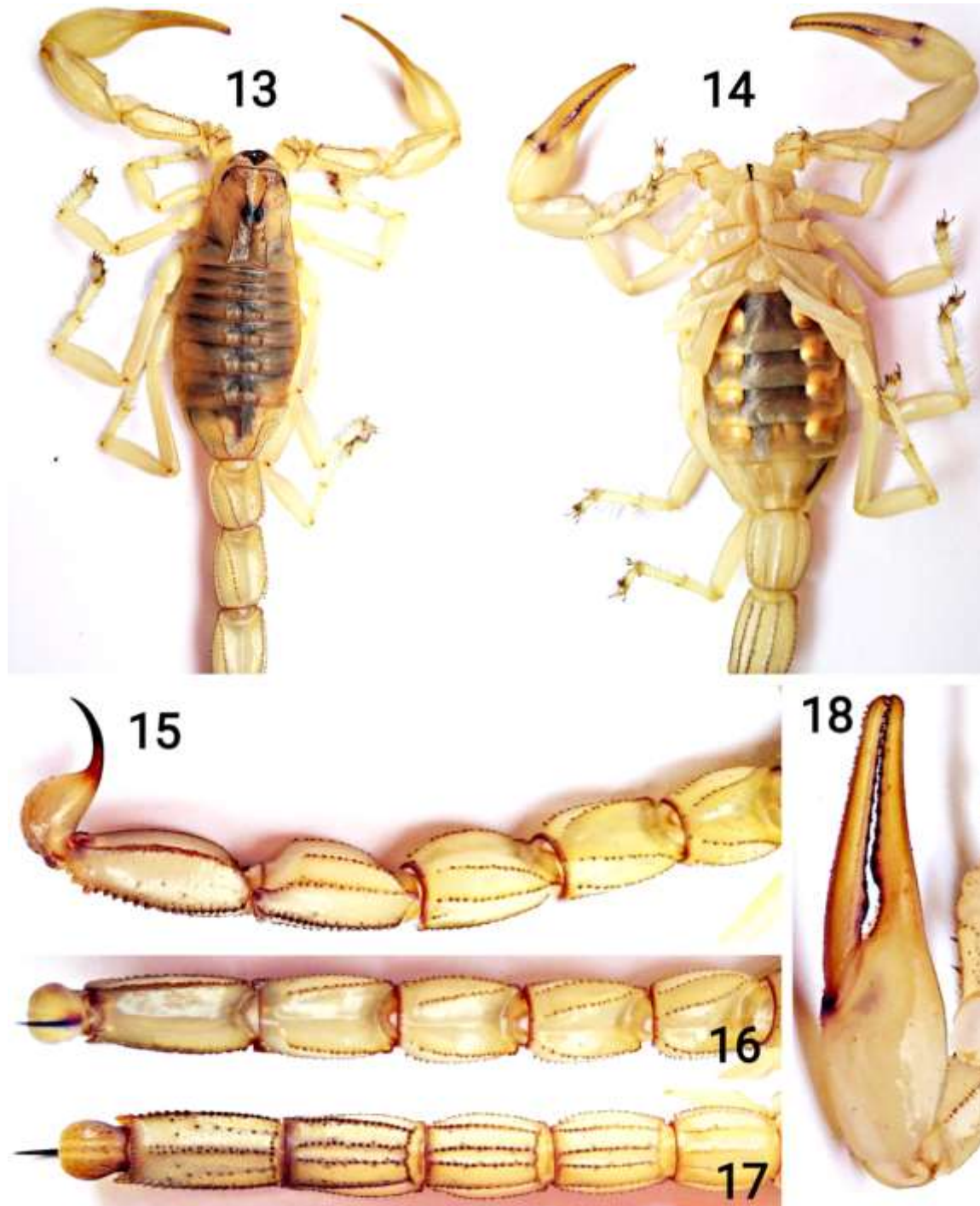
records of coordinates. A few authors have subsequently investigated this region, in an attempt to demystify the spread of the species further south. Touloun *et al.* (2014b: 18, fig. 2) reported three new localities in the rocky sandy region of Dakhla-Oued Ed Dahab: “Dar Amane” (22°38'43.2"N, 14°35'42.1"W; 284 m a.s.l.), “La Sebkha Imlily” (23°15'54.4"N, 15°54'08.5"W; 64 m a.s.l.; Touloun *et al.*, 2014b: fig. 1A-A'), and “Oued El Jena” (22°40'55.0"N, 14°29'44.4"W; 289 m a.s.l.). Touloun *et al.* (2016: table 1, fig. 1) further provided one record near Laayoune on the Atlantic coast (27°11'29.148"N, 13°19'50.808"W; 15 m a.s.l.). In conjunction with the report by Kovařík *et al.* (2016: 12) from Msied, these records are important observations regarding the dispersal of the species beyond its known southeastern distribution in Morocco. The documentation by Kovařík *et al.* (2016) extended its distribution area to Tan-Tan Province, which essentially bridged the record near Laayoune reported by Touloun *et al.* (2016).

Touloun *et al.* (2016: 880) also asserted that this species had been captured from the northeast Morocco near Oujda region, referencing to their paper in 2014. However, there was no report of this species from Oujda in Touloun *et al.* (2014a). Nevertheless, the same group of authors subsequently published a paper that included two maps with their cumulated records of *A. amoreuxi* across the entire Morocco (El Hidan *et al.*, 2017: figs. 1, 3). It is evident from their map that most records did not exceed the High-Atlas mountain range and constrained in the southeast area bordering Algeria, in concordance with most previous reports. The record from Oujda region was still not depicted in their map, but there is also one record that appeared to be located between the Middle-Atlas and High-Atlas mountain ranges, which remained enigmatic. However, Coelho *et al.* (2014: table 1) had mentioned a locality in the Jerada Province, which is just below the Oujda-Angad Province. More investigations are required to confirm this northern population.

Comparison with its congeners in Africa

Among its African congeners, *A. amoreuxi* appears to be most associated with *A. australis* (Linnaeus, 1758), *A. burkinensis*, *A. dekeyseri*, *A. eburneus* (Pallary, 1928), *A. maroccanus* Lourenço, Ythier & Leguin, 2009, *A. pallidus*, *A. tibesti* Lourenço & El-Hennawy, 2022 and *A. togolensis* Lourenço, 2008 in terms of the colouration and distribution. It can be confidently distinguished from *A. australis*, *A. dekeyseri* (cf. Lourenço, 2005: figs. 22-25), *A. maroccanus* (cf. MNHN-RS-RS8750, 8751), and *A. togolensis* (cf. MNHN-RS-RS8995) solely by its more slender metasoma. Type material of *A. eburneus* (a pair) are not observable to us, but Lourenço (2008: 39) suggested that this species is smaller (47.6 mm for male and 47.3 mm for female) than *A. amoreuxi* and possesses a higher PTC (male: 37-38 vs. 31-35; female: 22-24 vs. 21-25). However, it is uncertain if the type specimens of *A. eburneus* are immature, and the PTC discrepancy can be biased if the sample size is small. Geographically, the type locality of *A. eburneus* is located in the Tassili N'Ajjer National Park of Algeria, which is quite proximate to the asserted holotype of *A. amoreuxi* in Djanet. *A. burkinensis* was also differed from *A. amoreuxi* by a smaller size (holotype male 48.5 mm). One character that appeared to be reliable was the presence of an enlarged spinoid granule at the posterior end of the dorsosubmedian carinae of metasoma IV (cf. Ythier, 2021: fig. 3). This character was not observed in any of our examined specimens, as well as other individuals observed on iNaturalist (at least not as strong as what was illustrated for *A. burkinensis*). Moreover, the two species occupy distinct habitats and the distribution area of *A. burkinensis* is distant from the known area of *A. amoreuxi*. Another smaller species is *A. pallidus* (holotype male 67.5 mm), which appears to be more resemblant of *A. amoreuxi*. There is also one observation on iNaturalist seemingly conspecific with this species (obs. ID =

9897628). The more reliable character of those claimed by the authors appeared to be the lower DSC on the movable finger of chela (11 vs. 13; Lourenço, 2005: 158; Lourenço *et al.*, 2012: 312). However, problems are known to exist in the enumeration of denticle subrows, especially for the series near the proximity (Tang *et al.*, 2024: 11-12, 14). The assertion that “*chela without any scalloping of proximal dentate margin of fixed finger*”,



Figs. 13-18. A dead adult female from Achdad, Tinghir Province, observed by the first author and uploaded on iNaturalist (31°26'33.4"N, 5°26'17.8"W; 126853021). 13-14. Habitus. 13. dorsal view. 14. ventral view. 15-17. Metasoma. 15. lateral view. 16. dorsal view. 17. ventral view. 18. Left pedipalp chela, external view.

which is known to present in adult males of *A. amoreuxi*, could be subjectively biased by the degree of such feature (cf. Lourenço *et al.*, 2012: fig. 7). Nevertheless, we consider it as a valid species closely related to *A. amoreuxi* given its distribution. *A. tibesti* is a species occurring closely to both *A. amoreuxi* and *A. pallidus*, which was collected in the northeast of Tibesti Massif, Libya. According to the original description, although we are skeptical about the characters they proposed for distinguishing it from *A. pallidus*, this species can be differentiated from *A. amoreuxi* based on two characters shared respectively by *A. burkinensis* and *A. pallidus*, namely the strong spinoid granule at the posterior end of the dorsosubmedian carinae of metasoma IV, and a lower count of DSC on the movable finger of chela (11). It can be shown that this species does possess a pronounced spinoid granule (cf. MNHN-RS-RS9183) as opposed to *A. amoreuxi*.

Finally, we would like to share our doubts on the validity of another two congeners, namely *A. aleksandrplotkini* Lourenço & Qi, 2007 and *A. donairei* Rossi, 2015. However, before delving into this discussion, it is imperative to underscore the phylogenetic study conducted by Coelho *et al.* (2014), where *A. amoreuxi* was divided into three clades: clades AM1 and AM2 occurred in Morocco, clade AM2 also distributed in Tunisia and Algeria, and clade AM3 (based on specimens from local pet shops) was from Egypt. The genetic distance (mean *p*-distance) between AM1 and AM2 was 7.5%, while that between AM2 and AM3 was 8.9% (Coelho *et al.*, 2014: table 3). Those genetic distances were comparable with the genetic distance between *A. amoreuxi* and other undoubtedly distinct species (e.g., the genetic distance between AM1 clade and B2 clade of *A. bicolor* Ehrenberg, 1828 was 7.7%, and that between AM1 clade and B1 clade of *A. bicolor* was 8.8%). As stated by the authors, there were no significant morphological differences between the clades of *A. amoreuxi*. In fact, the type locality of this species was never specified as to which region in Egypt, not even in Audouin (1825: 173-174). The original diagnosis was also poor without useful information, and unfortunately, the holotype appeared to be lost. Thus, in a strict tone, due to the absence of a redescription based on the topotypes, none of the specimens in Morocco can be confidently assigned to the name *A. amoreuxi* considering the likelihood of this species being a complex comprising three cryptic clades as discovered by Coelho *et al.* (2014). Consequently, due to our limited knowledge constrained by the existing understanding of *A. amoreuxi*, we merely pose questions regarding those two species based on the prevailing consensus, refraining from suggesting any new synonyms, should any future study formally confirm the independence of those lineages.

The sole specimen of *A. aleksandrplotkini* (holotype female) was collected from Terjit, south of Atar town, in the north of Mauritania. Its overall habitus indicates that it is undoubtedly an immature female (cf. MNHN-RS-RS8980). The distinct colouration (cf. Lourenço & Qi, 2007: fig. 14) proposed by the authors as a diagnostic character, i.e., greyish yellow with dark brown stripes, is actually typical of the juvenile *A. amoreuxi* regardless of the locality (cf. Figs. 3, 11; also iNaturalist obs. IDs = 32950108, 53503746, 86226112, 109212317, 139034218, 156059597, 145131365, 164496747). Moreover, *A. amoreuxi* is sympatric with *A. aleksandrplotkini* in the region of Atar (Lourenço & Qi, 2007: fig. 15), which aligns with the known distribution of *A. amoreuxi* in Morocco. Both the DSC and PTC of the holotype female *A. aleksandrplotkini* (12 and 23-24) fall into a reasonable variation range of *A. amoreuxi*. Thus, there is a high likelihood that *A. aleksandrplotkini* represents a junior synonym of *A. amoreuxi*. A similar case concerns *A. donairei*: the holotype male, with a total length of 50 mm, possessed a DSC of 13 and a PTC of 32-34 (Rossi, 2015: 7). It is evident that this male was also immature (cf. Rossi, 2015: figs. 1-5). The morphological characters proposed by the author pertaining to the dark striped colouration, small size and lack of notch on pedipalp fingers were all again

in congruence with the characteristics of an immature *A. amoreuxi*. However, the type locality of this species falls into the distribution range of AM1 clade of *A. amoreuxi* (Zagora Province; 29°52'59.8"N, 6°07'09.2"W), distinct from the lineage in its type locality (i.e., AM3 clade in Egypt). The validity of this species can thus be only supported by a molecular study that did not introduce new taxa. More investigations are needed to confirm if these populations are completely non-overlapping. While the three lineages may represent valid, distinct species, the diagnosis proposed for *A. donairei* is nonetheless ineffective. Furthermore, if both *A. aleksandrplotkini* and *A. donairei* are distinct from *A. amoreuxi*, questions arise regarding the distinctness of *A. donairei* from *A. aleksandrplotkini*. If not, *A. aleksandrplotkini* would become the senior synonym of *A. donairei*.

Conclusion

The primary aim of this contribution is to unravel the mystery surrounding the distribution of *Androctonus amoreuxi* in Morocco. Based on our study on the past papers and field investigations, we reckon that this species occurs in a wider distribution than what it has been previously illustrated (Ythier & Lourenço, 2022: fig. 20). Our results show that this species mainly occupies a wide range along the border with Algeria and east to the Atlas mountain ranges, from Figuig Province in the north, through Errachidia, Tinghir, Zagora, and Tata provinces (probably Quarzazate as well), to Assa-Zag and Tantan provinces in the south, and finally entering the western Moroccan Sahara beyond which it meets with its Mauritanian populations (Fig. 1). In addition, we provide photos of live specimens in its wild habitat as a means to showcase its adaptations to the arid substrates. A brief rather than diagnostic description is provided, alongside an interspecific comparison with its African congeners, as a general guidance for the identification of this medically important species. Finally, we raise our questions concerning the true identity of *A. amoreuxi*, as well as the validity of several previously described species. We urge a comprehensive review of this species pertaining to its global populations, as well as a redescription and genetic analysis based on the study of its topotypes pending to be collected.

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Overview of the scorpion fauna of Morocco (Arachnida: Scorpiones)

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Abstract

Morocco hosts one of the most abundant and diverse scorpion faunas in North Africa and the Mediterranean region. This scorpion fauna is notable for marked endemism and medical significance, as it encompasses species confirmed to pose a danger to humans. The present study serves as a synthesis of the knowledge gathered regarding the inventory of this scorpion fauna from previously published works. The current checklist of this scorpion fauna includes 68 species and subspecies distributed across 12 genera and two families.

Keywords: Scorpiones, inventory, taxonomy, Morocco.

Introduction

Morocco has a rich scorpion fauna, characterized by marked endemism. Additionally, scorpion envenomation poses a public health problem in Morocco. The initial faunistic data concerning Moroccan scorpions were published by Pallary (1924, 1925, 1937), Charnot & Fauré (1934), and Sergent (1938), providing descriptions as isolated species.

The monograph by Vachon (1952) remains, thus far, the only comprehensive study on the systematics and distribution of scorpions in North Africa. It is through this work that the majority of the Moroccan scorpion fauna known at the time was studied.

Indeed, Vachon (1952) emphasized the complexity of this scorpion fauna, particularly in the genus level, including *Buthus* Leach, 1915, *Androctonus* Ehrenberg, 1828, and *Scorpio* Linnaeus, 1758. At that time, the scorpionic fauna in Morocco

comprised twenty-seven, subspecies and varieties distributed among seven genera and two families Buthidae and Scorpionidae.

Then, the inventory of the Moroccan scorpion fauna continues to be updated and new species has been identified, including new genera and subgenera. Thus forty-one species, two monospecific genera (*Saharobuthus* and *Cicileiurus*) and a subgenus *Gigantoloides* of the genus *Butheoloides* endemic to Morocco have been newly described (Lourenço, 2000, 2002c; Lourenço & Slimani, 2004; Lourenço & Geniez, 2005; Lourenço & Qi, 2006; Lourenço *et al.*, 2003, 2009, 2011, 2012; Teruel, 2007; Lourenço & Duhem, 2009; Touloun & Boumezzough, 2011; Rossi, 2015). Additionally, revisions of the genera *Buthus*, *Androctonus*, *Hottentotta*, and *Scorpio* have led to the elevation of twenty-four subspecies and varieties to the rank of species (Lourenço, 2003, 2005, 2009).

In recent years, other discoveries of new species have pertained to the genera *Androctonus*, *Buthus*, *Compsobuthus*, and *Scorpio* (Ythier & Lourenço, 2022; Ythier, 2023; Ythier & François, 2023).

Check list of Moroccan scorpiofauna

The current list of Moroccan scorpion fauna comprises sixty-eight 68 species and subspecies, distributed among twelve genera and two families. On the list, endemic genera and species are marked with an asterisk (*).

Family **Buthidae** C.L. Koch, 1837

Sub-family **Buthinae** Kraepelin, 1899

Genus ***Androctonus*** Ehrenberg, 1828

Androctonus agrab Ythier & Lourenço, 2022*

Androctonus amoreuxi (Audouin, 1825)

Androctonus australis (Linnaeus, 1758)

Androctonus barbouri (Werner, 1932)*

Androctonus bourdoni Vachon, 1948*

Androctonus donairei Rossi, 2015*

Androctonus gonneti Vachon, 1948*

Androctonus liouvillei (Pallary, 1924)*

Androctonus maroccanus Lourenço, Ythier & Leguin, 2009*

Androctonus mauritanicus (Pocock, 1902)*

Androctonus sergenti Vachon, 1948*

Genus ***Buthacus*** Birula, 1908

Buthacus arenicola maroccanus (Lourenço, 2006)*

Buthacus foleyi Vachon, 1948

Buthacus leptochelys (Ehrenberg, 1829)

Buthacus mahraoui Lourenço, 2004*

Buthacus occidentalis Vachon, 1953

Buthacus stockmanni Kovařík, Lowe & Stahlavsky, 2016*

Buthacus ziegleri Lourenço, 2000*

Genus ***Butheoloides*** Hirst, 1925

Butheoloides (Gigantoloides) aymerichi Lourenço, 2002*

Butheoloides (Butheoloides) littoralis Lourenço, Touloun & Boumezzough, 2011*

Butheoloides (Butheoloides) maroccanus Hirst, 1925*

Butheoloides (Butheoloides) occidentalis Lourenço, Slimani & Berahou, 2003*

Butheoloides (Butheoloides) slimanii Lourenço, 2010*

Genus ***Buthus*** Leach, 1815

Buthus albengai Lourenço, 2003*

- Buthus atlantis* Pocock, 1889*
Buthus bonito Lourenço & Geniez, 2005*
Buthus boumalenii Touloun & Boumezzough, 2011*
Buthus confluens Lourenço, Touloun & Boumezzough, 2012*
Buthus draa Lourenço & Slimani, 2004*
Buthus elmoutaouakili Lourenço & Qi, 2006 *
Buthus lienhardi Lourenço, 2003*
Buthus maamora Ythier, 2023*
Buthus malhommei Vachon, 1949*
Buthus mardochei Simon, 1878
Buthus mariefranceae Lourenço, 2003*
Buthus maroccanus Birula, 1903*
Buthus nigrovesiculosus Hirst, 1925*
Buthus oudjanii Lourenço, 2017*
Buthus paris (C.L. Koch, 1839)
Buthus parroti Vachon, 1949*
Buthus rochati Lourenço, 2003*
Buthus tunetanus (Herbst, 1800)
Genus ***Cicileiurus*** Teruel, 2007*
Cicileiurus monticola Teruel, 2007*
Genus ***Compsobuthus*** Vachon, 1949
Compsobuthus turieli Kovařík, Lowe, Stockmann & Stahlavsky, 2020*
Compsobuthus williamsi Lourenço, 1999
Genus ***Hottentotta***, Birula, 1908
Hottentotta franzwernerii (Birula, 1914)
Hottentotta gentili (Pallary, 1924)*
Hottentotta sousai Turiel, 2014*
Genus ***Lissothus*** Vachon, 1948
Lissothus occidentalis Vachon, 1950
Genus ***Microbuthus*** Kraepelin, 1898
Microbuthus fagei Vachon, 1949
Microbuthus maroccanus Lourenço, 2002*
Genus ***Orthochirus*** Karch, 1891
Orthochirus cloudsleythompsoni Lourenço & Leguin, 2011*
Orthochirus innesi Simon, 1910
Orthochirus maroccanus Lourenço & Leguin, 2011*
Genus ***Saharobuthus*** Lourenço & Duhem, 2009*
Saharobuthus elegans Lourenço & Duhem, 2009*

Family of ***Scorpionidae*** Latreille, 1802
Sub-family of ***Scorpioninae*** Pocock, 1893
Genre ***Scorpio*** Linnaeus, 1758
Scorpio birulai Fet, 1997
Scorpio fuliginosus (Pallary, 1928)*
Scorpio hesperus Birula, 1910
Scorpio iznassen Ythier & François, 2023*
Scorpio maurus behringsi Schenkel, 1949*
Scorpio maurus legionis Werner, 1932*
Scorpio maurus stemmleri Schenkel, 1949*
Scorpio mogadorensis Birula, 1910*

Scorpio moulouya Ythier & François, 2023*
Scorpio punicus Fet, 2000
Scorpio touili Ythier & François, 2023*
Scorpio tunetanus Herbst, 1800
Scorpio weidholzi Werner, 1929*

Presentation of the scorpion fauna of Morocco

***Androctonus* Ehrenberg, 1828**

The genus *Androctonus* has a wide geographic distribution in North Africa and the Middle East, extending even to India. In the south, it has been collected in Senegal and the upper basin of the Nile (Fet, 1988). North Africa is a major hotspot for this genus (Coelho *et al.*, 2014). According to Vachon (1952), this genus was initially composed of several subspecies. Subsequently, a taxonomic revision of the genus led to the elevation of some subspecies to the species level. Thus, *A. mauritanicus mauritanicus* and *A. mauritanicus bourdoni* became *A. mauritanicus*; while, *A. crassicauda gonneti* Vachon, 1948 became *A. gonneti* (Lourenço, 2005). Recently, *A. mauritanicus bourdoni* has been raised to species rank as *Androctonus bourdoni* Vachon, 1948 stat. n (Ythier & Lourenço, 2022).

A. australis was considered absent in Morocco for a long time until its identification in the east of the country, 24 km north of Bouârfa towards Tendirara (Geniez, 2009). In the same year, a new species *A. maroccanus* was described from Sidi Smail village east of Eljadida in the central-western Morocco (Lourenço *et al.*, 2009). Later, *A. donairei* was described from a male specimen collected in the Guelmim region (Rossi, 2015). *A. barbouri* (Werner, 1932) was initially described as *Buthus barbouri* in the region of Agadir. It was considered an uncertain species by Vachon (1952) before being transferred to the genus *Androctonus* in 2017 (Sousa *et al.*, 2017).

In another study, Coelho *et al.* (2014) assessed the phylogeographical patterns in six species of *Androctonus* scorpions from North Africa using mitochondrial DNA markers. They found taxonomically and geographically coherent clades and discovered deep intraspecific variation in the widespread *Androctonus amoreuxi* and *Androctonus australis*, which are consisted of several well-supported clades. Genetic distances between some of these clades are as high as those found between species. These authors also found deep divergences in *Androctonus mauritanicus*, corresponding to areas attributed to invalidated subspecies. In addition they uncovered a clade of specimens from coastal south Morocco, which could not be ascribed to any known species using morphological characters.

In 2022, a new species, *Androctonus agrab*, was described from Adrar-Sotuf, located 200 km south of Dakhla and 150 m east of the Atlantic coast. The specimen has been deposited in the collection of the Muséum national d'Histoire naturelle in Paris (Ythier & Lourenço, 2022). This new scorpion taxon represents the 33rd known species of the genus *Androctonus* reported (Ythier & Lourenço, 2022). In Morocco this genus is currently represented by 11 species including 9 endemic species.

***Buthacus* Birula, 1908**

The genus *Buthacus* was considered as subgenus of the genus *Buthus* with a wide distribution (Vachon, 1952). The same author had suggested that *B. leptochelys* and *B. arenicola* could represent two distinct complexes of species. Currently, this genus is represented in Morocco by six species and a sub species:

* *B. leptochelys*: occupies the region of M'Hamid El Ghizlane, Merzouga, south of Erfoud and Erg Chebbi (Kovářík, 2005).

* *B. occidentalis*: corresponds to the subspecies *B. leptochelys occidentalis* known from Tiznit and the Drâa valley which has been elevated to the rank of species (Lourenço, 2000).

* *B. mahraouii*: its description is based on a single male specimen discovered near the Algerian borders in the north-west of Beni Abbès (Lourenço, 2004).

* *B. foleyi*: was known originally to present only in Algeria and Tunisia. Its reported discovery in Morocco in 2005 by Kovařík from northern Boudnib in eastern Morocco, was later cast into doubt by Lourenço (2006) in a subsequent publication. Lourenço suggested that the citation of Kovařík (2005) is likely due to an identification error.

* *B. ziegléri*: is described from the mountainous areas of the north-west of Erfoud. Others new specimens were discovered by Kovařík *et al.* (2016b) further south of the first locality (Lourenço, 2000).

* *B. stockmanni*: is described from north of Msied, north of Zag, east of Laayoune, and north of Smara in southern Morocco (Kovařík *et al.*, 2016b).

* *B. arenicola maroccanus*: is described in the region of Zagora and Tagounit in the Draa valley (Lourenço, 2006). Lourenço (2017b) suggested the synonymy of this species with *Buthacus arenicola maroccanus*. Kovařík *et al.* (2016b) pointed out the synonymy between *B. huberi* and *B. occidentalis* Vachon, 1953 as well as a synonymy between *B. mahraouii* and *B. leptochelys algerianus* along with *B. ziegléri*.

***Butheoloides* Hirst, 1925**

The genus *Butheoloides*, endemic to Africa, has a Perisaharan distribution. In Morocco, it remained monospecific after the generic type description, *Butheoloides maroccanus* in 1925 (Vachon, 1952), until 2002, when *Butheoloides* (*Gigantoloides*) *aymerichi* and the new subgenus, *Gigantoloides* were described in Tineghir region (Lourenço, 2002c). Subsequently three other species of the genus belonging to the subgenus *Butheoloides* were created:

* *B. (Butheoloides) occidentalis* described from the region of Tan Tan (Lourenço *et al.*, 2003).

* *B. (Butheoloides) slimanii* described from the Tanant region (south of Azilal) (Lourenço, 2010).

* *B. (Butheoloides) littoralis* described from the beach of Lagzira north of Sidi Ifni in south-west Morocco (Lourenço *et al.*, 2011).

***Buthus* Leach, 1815**

The genus *Buthus* has a wide geographic distribution in Africa, Middle East, Asia, and Europe. Due to the complexity of this genus, its species were subdivided into several subspecies and varieties including among the species *B. occitanus*, in the monograph of Vachon (1952).

In the world catalog of scorpions (Fet *et al.*, 2000), all varieties established by Vachon (1949, 1952) are no longer considered valid. Since Vachon's monograph (1952) on systematics and the distribution of North African scorpions, no new species of the genus has been described in this territory until 2002 when Lourenço (2002a) described *B. tassili* from the Tassili des Ajjer mountains south of Algeria.

Lourenço (2003) revised the North African scorpions of the genus *Buthus*. He described several new species including some subspecies and varieties that Vachon had described, based on the collections of the Natural History Museum of Geneva. Thus, among the subspecies and varieties that composed *B. occitanus*, six of them have been elevated to the species rank. After this revision, the subspecies, *B. occitanus* s. sp. *malhommei*, *B. occitanus* s. sp. *paris* became respectively *B. occitanus* (Amoreux, 1789),

B. malhommei Vachon, 1949, and *B. paris* (C.L. Koch, 1839). Also, four other species were suggested by Sousa *et al.* (2017):

* *B. nigrovesiculosus*, originally described as *B. europaeus nigrovesiculosus* Hirst, 1925 and also cited as *B. occitanus nigrovesiculosus* Fet & Lowe, 2000. The locality type is the Dakhla region in southern Morocco.

* *B. tunetatus*, originally described as *B. occitanus tunetanus* (Herbst, 1800) from Tarda (Errachidia region).

* *B. parroti* already described as *B. atlantis parroti* Vachon 1949 from the Souss plain.

* *B. atlantis* already described as *B. atlantis atlantis* Pocock, 1889 from the Moroccan Atlantic coast.

Five varieties already described by Vachon (1949) have been elevated to the rank of species. Thus, *B. occitanus* s.sp. *mardochei* var. *mardochei* Simon, 1878; *B. occitanus* s.sp. *mardochei* var. *mimeuri* Vachon, 1949; *B. occitanus* s.sp. *mardochei* var. *panousei*; Vachon, 1949 and *B. occitanus* s.sp. *tunetanus* var. *lepineyi* Vachon, 1949 became respectively *B. mardochei* Simon, 1878, *B. mariefranceae* Lourenço, 2003, *B. rochati* (Lourenço, 2003) and *B. lienhardi* Lourenço, 2003. After the revision, *B. occitanus* s.sp. *mardochei* var. *alluaudi* Vachon, 1949 became *B. elmoutaouakili* (Lourenço & Qi, 2006).

Subsequently six species of the genus were described:

* *B. albengai* from the Ifrane region in the Middle Atlas (Lourenço, 2003).

* *B. draa* from the Drâa valley in central-eastern Morocco (Lourenço & Slimani, 2004).

* *B. bonito* near the Khnifis lagoon north of Tarfaya in west-central Morocco (Lourenço & Geniez, 2005).

* *B. boumalenii* described from Boumalène Dadès in the centre of Morocco (Touloun & Boumezzough, 2011).

* *B. confluens* described from the municipality of Elhamra to south from Tetouan in northern Morocco (Lourenço *et al.*, 2012).

* *B. oudjani* from the Camel Cave in Tafoughalt in the northeast of Morocco (Lourenço, 2017a).

A molecular study was started to elucidate the patterns of diversity within this genus in the Iberian Peninsula and the Maghreb (Sousa *et al.*, 2012). In this study, they evaluated the diversity patterns of *Buthus* scorpions from across the Maghreb region of North Africa using CO1 DNA sequence data. Three clades were confined to Morocco and seem to have originated from the Atlantic Coast of this country, while the fourth was observed throughout the region.

In another study, Habel *et al.* (2012) examined the influence of geographic structures on the phylogenetic patterns among *Buthus* scorpions using mtDNA sequences. They sampled 91 individuals of genus *Buthus* from 51 locations scattered around the Atlas Mountains. Consequently, genetic structure and geographical distribution of genetic (sub)clusters conform to the classical theory of allopatric differentiation, wherein distinct groups evolve without range overlap until reproductive isolation and ecological differentiation has built up.

A recently described species, *B. maamora*, is distributed along the Atlantic coast, extending from Kenitra to El Jadida. In the southern region, it is replaced by *B. atlantis* from Safi. This species exhibits affinities with both *B. atlantis* (Pocock, 1889) and *B. parroti* (Vachon, 1949), but it can be readily distinguished from these two species by a combination of several key characters (Ythier, 2023).

***Cicileiurus* Teruel, 2007**

This genus includes a single species *Cicileiurus monticola* Teruel, 2007 described from the High Atlas central at 2000 m of altitude. It is closely related to *Cicileus* Vachon

1948 and *Leiurus* Ehrenberg 1828, but exhibits remarkably unique characters. It is very interesting from a biogeographical point of view, because it seems to represent a geographical vicariant of the two mentioned genera as well as an isolated mountain relict (Teruel, 2007).

***Compsobuthus* Vachon, 1949**

Before the creation of this genus, its species were placed in genus *Buthus*. It has a wide distribution from Morocco and Mauritania to India in the east (Kovářík *et al.*, 2016a). In Morocco it is represented by a single species *Compsobuthus williamsi* (Lourenço, 1999) reported only once in Morocco between Erfoud and Ouarzazate (Lourenço, 1999). Kovářík (2018) synonymized it with *C. matthiesseni* (Birula, 1905), recognized in Iran, Iraq, Syria and Turkey. However, this decision must be reviewed regarding the geographic distribution of these species.

A new species of this genus, *Compsobuthus turieli* Kovářík, Lowe, Stockmann & Šťáhlavský, 2020, has been described approximately 70 km south of Dakhla, in the southern region of Morocco. The specimens were discovered beneath rocks in arid sandy terrain with relatively sparse vegetation. Other scorpions observed in proximity to this species included *Androctonus amoreuxi* (Audouin, 1825), *Buthacus stockmanni* Kovářík, Lowe & Šťáhlavský, 2016, and *Lissothus occidentalis* Vachon, 1950, in sandy areas; and *Buthus mariefranceae* Lourenço, 2003, in loamy areas (Kovářík *et al.*, 2020).

***Hottentotta* Birula, 1908**

Previously known as *Buthotus*, this genus is distributed across Africa, the Middle East, Central Asia and South Asia (Sousa *et al.*, 2011). In Morocco, it is currently represented by three species:

* *H. franzweneri*: formerly recognized as *Buthotus franzweneri franzweneri* inhabiting the east of the Drâa valley. It is also found in Algeria (Vachon, 1952).

* *H. gentili*: previously identified as *Buthotus franzweneri gentili*, it occupies southern Morocco, extending to the Haouz plain (Vachon, 1952).

* *H. sousai*: described in the southern regions of Morocco using molecular biology techniques (mitochondrial DNA) based on specimens collected from the Tan Tan region (Turiel, 2014).

***Lissothus* Vachon, 1948**

Lissothus occidentalis is the sole representative of this genus in Morocco. It has been collected from Akka in the Anti Atlas, north of Zag, in Targa Wassay and Semara (Stockmann *et al.*, 2016).

***Microbuthus* Kraepelin, 1898**

Genus *Microbuthus* remains inconspicuous with a low number of species, considered rare due to the very low population densities (Lourenço, 2002b), as well as the small sizes and cryptic forms of its species (Touloun, 2012).

In Morocco, this genus is represented by two species:

* *M. fagei*: Until recently, *M. fagei* which inhabits the Mauritanian coast, was not known in Morocco. Its presence in the country was first documented by Delacour & Dupré (1992) who found it 17 km north of Tan-Tan plage and later by Touloun *et al.* (1997) 60 km west of Smara in the south from Morocco.

* *M. maroccanus*: The examination of material from the lower valley of the Oued Drâa (20 km north of Tan-Tan) led Lourenço (2002c) to describe this species after a

comparative study with specimens collected in Mauritania. Subsequently, Lourenço & Duhem (2007) elevated it to the rank of species.

***Orthochirus* Karch, 1891**

This genus has a broad distribution from Morocco to Senegal in the west to India in the east (Kovařík, 1995). In Morocco, it currently comprises three species:

- * *O. innesi*: originally described from Egypt, its presence in Morocco was initially reported by Kovařík (1995). This species is known to inhabit the oases of the Anti Atlas and the Draa Valley.
- * *O. cloudsleythompsoni*: described in the Tata region in central eastern Morocco (Lourenço & Leguin, 2011a).
- * *O. maroccanus*: originally described from a locality between Assa and Aouinet Torkoz (Lourenço & Leguin, 2011b).

***Saharobuthus* Lourenço & Duhem, 2009**

This genus has been described in the Adrar region-Sotuf from the extreme south of Morocco with the only species *Saharobuthus elegans* (Lourenço & Duhem, 2009). Its name makes reference to its type locality which is the Sahara. This newly created genus shows taxonomic affinities with the genera *Mesobuthus*, *Sassanidotus*, and *Compsobuthus* (Lourenço & Duhem, 2009).

***Scorpio* Linnaeus, 1758**

This genus was created by Linnaeus in 1758. For many decades, a single widespread species and probably highly polymorphic was recognized as: *Scorpio maurus* L., 1758. In fact, until the end of the 19th century, the presence of more than one species was accepted by several authors, including Simon (1872), Kraepelin (1899), Pocock (1900), and Birula (1910). The latter author was the first to publish a detailed review of the forms associated with this species, which he interpreted as subspecies. By revising the North African lineage of the genus, Vachon (1952) confirmed the distribution of this genus into several subspecies. Cloudsley-Thompson & Lourenço (1994) had suggested that the overall populations of *Scorpio maurus* can represent a very large complex of polymorphic species.

In 2009, the revision of the genus led to the elevation of certain subspecies of *S. maurus* including Moroccan forms to the rank of the species (Lourenço, 2009). Consequently, six subspecies were reclassified as distinct species:

- * *Scorpio birulai*: initially described as *Scorpio maurus birulai* Fet, 1997. Fet (1997) who later synonymized it with *S. maurus subtypicus* Birula, 1910. Kovařík (2009) further synonymized it with *S. weidholzi*.
- * *Scorpio fuliginosus*: described by Pallary (1928) as *Heterometrus fuliginosus*, being classified as *Scorpio maurus fuliginosus* by Schenkel in 1949. It is known from the High Moroccan Atlas.
- * *Scorpio mogadorensis*: was described by Birula (1910) as *Scorpio maurus mogadorensis* from Essaouira region.
- * *Scorpio hesperus*: initially described by Birula (1910) as *Scorpio maurus hesperus*. Kovařík (2009) had synonymized it with *S. weidholzi*.
- * *Scorpio punicus*: described by Fet (2000) as *Scorpio maurus punicus* synonymized with *Scorpio maurus tunetanus* Birula, 1910.
- * *Scorpio weidholzi*: originally described as *Scorpio maurus weidholzi* from the Haouz plain in central Morocco (Werner, 1929).

However, the taxonomic status of three other subspecies remains to be revised and clarified:

* *Scorpio maurus legionis*: originally described from the Tandrara region in eastern Morocco by Werner (1932). This subspecies is synonymous with *S. fuliginosus* (Kovářik, 2009).

* *S. maurus stemmleri*: described from the Demnate region in central Morocco.

* *S. maurus behringsi*: described from Morocco without further details (Schenkel, 1949).

The last two subspecies have been reported “*nomina dubia*” (Kovářik, 2009) indicating uncertain taxonomic status.

Recently, three new species were described based on material collected in the high plateaus of the Oriental region (*S. touili*), in the Beni Snassen mountains (*S. iznassen*), and in the middle Moulouya river basin (*S. moulouya*) (Ythier & François, 2023). These new taxa increase the number of known species for the genus *Scorpio* in Morocco to thirteen.

A study conducted by Froufe *et al.* (2008) identified variation within the mitochondrial cytochrome oxidase 1 (CO1) gene by examining specimens of this genus in Morocco. High levels of genetic diversity were observed, showing some geographic consistency.

Analysis of species richness and distribution of the scorpion fauna

Approximately 81% of the species described in Morocco belong to the Buthidae family (Table 1). Within this family, the most diversified genus is *Buthus*, represented by 19 species, followed by the genus *Androctonus* with 11 species. These two genera are distributed throughout the Moroccan territory, and they exhibit high percentages of endemism, with 84.21% and 81.82%, respectively. The genera *Butheoloides*, *Cicileiurus*, and *Saharobuthus* show endemism percentages around 100%. The latter two genera are endemic to Morocco.

The distinctive feature of this scorpion fauna is its remarkable endemism. In fact, two genera, *Saharobuthus* and *Cicileiurus*, and 75% of the described species are endemic to Morocco (Table 1).

Table 1. Distribution of described scorpion species and endemic species in Morocco by genera.

| Genus | Number of species described | Number of species endemic to Morocco | % of endemism |
|---------------------|-----------------------------|--------------------------------------|---------------|
| <i>Androctonus</i> | 11 | 9 | 81,82 |
| <i>Buthacus</i> | 7 | 4 | 57,14 |
| <i>Butheoloides</i> | 5 | 5 | 100 |
| <i>Buthus</i> | 19 | 16 | 84,21 |
| <i>Cicileiurus</i> | 1 | 1 | 100 |
| <i>Compsobuthus</i> | 2 | 1 | 50 |
| <i>Hottentotta</i> | 3 | 2 | 66,67 |
| <i>Lissothus</i> | 1 | 0 | 0 |
| <i>Microbuthus</i> | 2 | 1 | 50 |
| <i>Orthochirus</i> | 3 | 2 | 66,67 |
| <i>Saharobuthus</i> | 1 | 1 | 100 |
| <i>Scorpio</i> | 13 | 9 | 69,23 |
| Total | 68 | 51 | 75 |

According to Vachon (1952), the distribution of scorpions in northern Africa can be explained by paleogeography and paleoclimatology (Vachon, 1952). In Morocco, the central regions are the most diverse in terms of this fauna (Touloun, 2012; Touloun *et al.*, 2016; El Hidan, 2016). This high diversity is attributed to the heterogeneity of landforms, substrata and habitats in the area. Hotspots are generally less represented in regions with homogeneous environments such as the Saharan regions of Morocco. The endemic species hotspots show a similar trend to that of the total species distribution (El Hidan *et al.*, 2021).

Conclusion

Several authors have highlighted the complexity of taxonomy of the scorpion fauna of Morocco. That's why other species and genera of scorpions continue to be unveiled in Morocco. But it is important to note that vast regions have not been thoroughly surveyed yet. Other studies in these regions tend to indicate that they can sustain a highly diverse scorpion fauna, potentially encompassing several new species and even new genera.

To support or clarify certain taxonomic status within the scorpion fauna of Morocco, it would be interesting to use molecular biology to detect differences between populations. Several studies of these genera have been successful in providing new taxonomic data, biogeographic and phylogenetic information related to the scorpion fauna of Morocco as with the genera *Buthus*, *Androctonus*, *Buthus*, *Hottentotta*, and *Scorpio*. However, it will be interesting to extend this type of study to other genera, such as *Buthacus* and *Orthochirus*. Also, a comprehensive morphological and molecular revision is necessary for certain species within these genera which have wide distribution in Morocco.

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Discovery of the alien spider *Erigone dentosa* O. Pickard-Cambridge, 1894 (Araneae: Linyphiidae) in Türkiye

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Abstract

This short paper reports one linyphiid species new to the Turkish araneo-fauna. Characteristic features and photographs of *Erigone dentosa* O. Pickard-Cambridge, 1894 are presented. Its presence represents the easternmost boundary of this species in Europe.

Keywords: Araneae, Linyphiidae, *Erigone dentosa*, new record, systematics, Türkiye.

Introduction

Linyphiidae Blackwall, 1859 is the second largest family in Order Araneae and is currently represented by 4846 species belonging to 634 genera in the worldwide (World Spider Catalog, 2024). Within this large family, Genus *Erigone* Savigny, 1825 is represented by 111 species and subspecies (World Spider Catalog, 2024). Up to now, 27 of these species and subspecies have been observed in Europe (Nentwig *et al.*, 2024). Linyphiidae is represented by a total of 156 species of 74 genera in Türkiye (Danişman *et al.*, 2024; Demir & Seyyar, 2017). There are two species of *Erigone* are recorded in Türkiye: *Erigone atra* Blackwall, 1833 and *E. dentipalpis* (Wider, 1834) (Danişman *et al.*, 2024; Demir & Seyyar, 2017). The goal of this short paper is to provide new data about the *Erigone* of Türkiye. With this study, the number of linyphiid species belonging to Turkish spider fauna has been raised to 157.

Material and Methods

One male specimen was examined in this study. It was collected by means of a hand aspirator. Identification was made by use of Leica S8APO stereomicroscope. Digital images were created using a Canon EOS 250D camera attached to Leica S8APO microscope. Images were montaged using “CombineZM” image stacking software and “Photoshop CS5” image editing software. Measurements are given in millimetres. The studied specimen is preserved in 70% ethanol and deposited in the collection of the Arachnological Museum of Kırıkkale University (KUAM). All measurements are in millimetres. Leg measurements are shown in the following order: femur (Fe), patella (Pa), tibia (Ti), metatarsus (Mt), tarsus (Ta), total length. The map showing the distribution of the species in this study was generated with the SimpleMappr (Shorthouse, 2010) (Fig. 1). Identification depended on references of Nentwig *et al.* (2024).



Fig. 1. Distribution map of *Erigone dentosa* O. Pickard-Cambridge, 1894 (red star) in Türkiye.



Fig. 2. Habitat of *Erigone dentosa* O. Pickard-Cambridge, 1894 in Türkiye.

Results

Family **Linyphiidae** Blackwall, 1859

Genus ***Erigone*** Savigny, 1825

Erigone dentosa O. Pickard-Cambridge, 1894

Material examined: 1♂, Türkiye, Bursa Province, Gürsu District, 40°14'36.2"N, 29°12'12.6"E elev. 98 m, 11.12.2023, T. Danışman leg., from leaf debris under a pear orchard (Fig. 2).

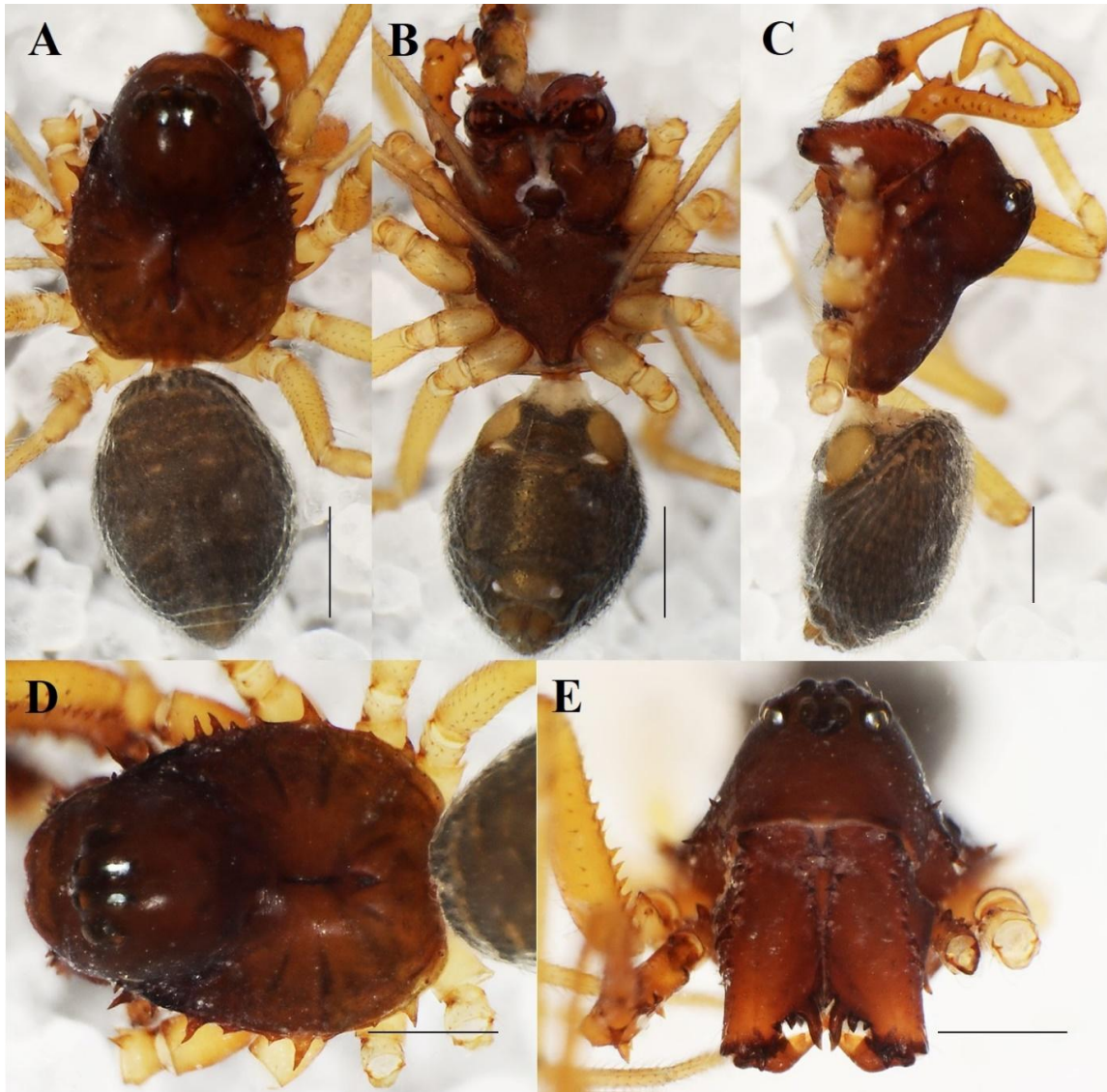


Fig. 3. *Erigone dentosa*, male. A-C. Habitus. A. dorsal view. B. ventral view. C. lateral view. D-E. Prosoma. D. dorsal view. E. frontal view. (Scale bar: 0.5 mm).

Male. Measurements: Total length 2.85. Prosoma length 1.5, width 1.1, height 1.1. Abdomen length 1.35, width 0.95, height 0.90. Ocular area length 0.4. Clypeus height 0.3. Chelicerae length 0.8, width 0.3. Sternum length 0.65, width 0.75. Leg formula IV, I, II, III. Lengths of legs: I. Fe 1.1, Pa 0.3, Ti 0.9, Mt 0.8, Ta 0.5, Total 3.6; II. Fe 1.0, Pa 0.3, Ti 0.8, Mt 0.8, Ta 0.5, Total 3.4; III. Fe 0.8, Pa 0.2, Ti 0.7, Mt 0.7, Ta 0.5, Total 2.9; IV. Fe 1.1, Pa 0.3, Ti 1.0, Mt 0.9, Ta 0.5, Total 3.8.

Prosoma reddish orange, with dark lines radiating from the median strip. Both sides of the prosoma with large and small spines. Cephalic region of prosoma elevated to form a large lobe (Figs. 3A,D). Opisthosoma grey, with typical pattern (Fig. 3A). Sternum dark reddish brown, labium and maxillae brown (Fig. 3B). Chelicerae brown, with long marginal spines, and long cheliceral teeth. Clypeus brown (Fig. 3E). Pedipalp femur has row of hook-shaped 6 spines and 1 distal pair of spines, patella with hooked spines and a long, subsequent apophysis (Figs. 4A-B). Tibial apophysis with two apophyses, "v" shaped. Pedipalp characteristics (Figs. 4A-F).



Fig. 4. *Erigone dentosa*, male, pedipalp. A-B. whole palp. C. lateral view. D. prolateral view. E. ventral view. F. retrolateral view. (Scale bar A-B: 0.5 mm, C-F: 0.2 mm).

Distribution: Canada, USA, Mexico, Guatemala. Introduced to Europe (World Spider Catalog, 2024). Now, it is established in: Belgium, Bulgaria, Czechia, Denmark, France, Germany, Netherlands, Norway, Portugal, Spain, Switzerland, United Kingdom (Nentwig *et al.*, 2024).

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***Titanoeca flavicoma* L. Koch, 1872 (Araneae: Titanoecidae) in Türkiye**

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Abstract

This short paper reports a titanoecid species new to the araneofauna of Türkiye, *Titanoeca flavicoma* L. Koch, 1872. Its morphology is briefly described and illustrated. The distribution of this species in Türkiye is also mapped.

Keywords: Biodiversity, Mediterranean, morphology, new record, taxonomy.

Introduction

Family Titanoecidae Lehtinen, 1967 is represented by 5 genera and 67 species in the world (World Spider Catalog, 2024) and 25 species in Europe (Nentwig *et al.*, 2024). Within this family, genus *Titanoeca* Thorell, 1870 is represented by 31 species in the world (World Spider Catalog, 2024). Until now, 6 titanoecid species belong to 2 genera have been reported from Türkiye (Danışman *et al.*, 2024), including only 4 species belonging to genus *Titanoeca*. These species are *Titanoeca caucasica* Dunin, 1985, *T. incerta* (Nosek, 1905), *T. quadriguttata* (Hahn, 1833), and *T. schineri* L. Koch, 1872 (Danışman *et al.*, 2024; Demir & Seyyar, 2017). Members of Titanoecidae are medium-sized cribellate spiders whose bodies are covered with velvet-like black hairs. These spiders create neat webs under stones among leaves or low vegetation. The abdomen of males usually bears paired white spots, the number of which varies according to the

genera. This paper presents the characteristic features and distribution of *Titanoeca flavicoma* L. Koch, 1872 (♂,♀) adding a new species to the araneo-fauna of Türkiye.

Material and Methods

In this study, samples were collected from under stones in Mersin province (Fig. 1) with the help of a hand aspirator. Identification and measurements of the samples were made with a Leica S8APO stereomicroscope. The female genitalia were dissected and cleaned in 88% lactic acid solution for 2-3 days. The photos were taken with the Canon EOS 250D camera. Images have been edited by 'Combine ZM' image stacking software and 'Photoshop CC 2019' image editing software. The map was prepared using SimpleMappr program (Shorthouse, 2010). Specimens were preserved in 70% ethanol. The specimens were deposited in the collection of the Arachnological Museum of Kırıkkale University (KUAM). Measurements are given in millimetres. Measurements of legs are shown as total length (femur (Fe), patella (Pa), tibia (Ti), metatarsus (Mt), tarsus (Ta)). Identification depended on references of Nentwig *et al.* (2024).



Fig. 1. Distribution map of *Titanoeca flavicoma* L. Koch, 1872 (red star) in Türkiye.

Results

Family ***Titanoecidae*** Lehtinen, 1967

Genus ***Titanoeca*** Thorell, 1870

Titanoeca flavicoma L. Koch, 1872

Material examined: 1♂, 3♀♀ Mersin Province, Tarsus District (37°03'04"N, 34°55'26"E), elevation 221 m, 24.04.2013, leg. M. Erdek, found under stone.

Description: Male. Total length 5.9. Carapace 2.8 long, 2.2 wide. Abdomen 3.1 long, 1.8 wide. Ocular area 0.8 long. Chelicerae 1.3 long, 0.65 wide. Sternum 1.3 long, 1.1 wide. Leg formula I, IV, II, III. Leg lengths: I 8.8 (Fe 2.5, Pa 0.9, Ti 2.3, Mt 2.1, Ta 1.0), II 6.7 (Fe 2.1, Pa 0.8, Ti 1.8, Mt 1.2, Ta 0.8), III 6.3 (Fe 1.9, Pa 0.8, Ti 1.4, Mt 1.5, Ta 0.7), IV 7.7 (Fe 2.2, Pa 0.9, Ti 2.0, Mt 1.8, Ta 0.8). Carapace yellowish brown (Fig. 2A). Clypeus narrow, yellowish brown (Fig. 2C). Chelicerae long, dark brown, dorsally with long dark setae (Fig. 2C). Sternum dark brown, with setae and edges dark (Fig. 2B). Labium and maxillae dark brown (Fig. 2B). Abdomen dark grey, densely covered with long dark hairs (Fig. 2A), ventrally dark grey (Fig. 2B). Legs yellowish brown and covered with long

light hairs (Figs. 2A-B). Tibial apophyses complex bipartite, with a dorsal ear-like lamella. Prolateral tibial apophysis is hook-shaped, relatively simple and small compared to closely related species (Figs. 3A-E).

Female. Total length 7.4. Carapace 2.8 long, 2.0 wide. Abdomen 4.6 long, 3.2 wide. Ocular area 1.0 long. Chelicerae 1.45 long, 0.75 wide. Sternum 1.4 long, 1.1 wide. Leg formula I, IV, II, III. Leg lengths: I 7.1 (Fe 2.1, Pa 0.9, Ti 1.7, Mt 1.5, Ta 0.9), II 6.1 (Fe 1.8, Pa 0.8, Ti 1.4, Mt 1.3, Ta 0.8), III 5.4 (Fe 1.7, Pa 0.7, Ti 1.2, Mt 1.1, Ta 0.7), IV 6.8 (Fe 2.1, Pa 0.9, Ti 1.7, Mt 1.4, Ta 0.7). Carapace dark brown (Fig. 2D). Its anterior part higher than posterior. Clypeus narrow, brown (Fig. 2F). Chelicerae long (shorter than male), dark brown, dorsally with long dark setae (Fig. 2F). Sternum dark brown, with setae (Fig. 2E). Labium and maxillae dark brown (Fig. 2E). Abdomen light grey, densely covered with short dark hairs (Fig. 2D), ventrally dark grey (Fig. 2E). Legs brown and covered with long light hairs (Figs. 2D-E). Epigyne dome shaped and triangular, with elongated copulatory duct. Spermathecae round, relatively small, separated from each other by two times their diameter (Figs. 4A-C).

Distribution: France (Corsica), Italy, Albania, North Macedonia, Bulgaria, Greece, Israel (World Spider Catalog, 2024).



Fig. 2. *Titanoeca flavicoma* L. Koch, 1872, Habitus. A-C. male. D-F. female. A, D. dorsal view, B, E. ventral view, C, F. frontal view. (Scale bar: 0.5 mm).

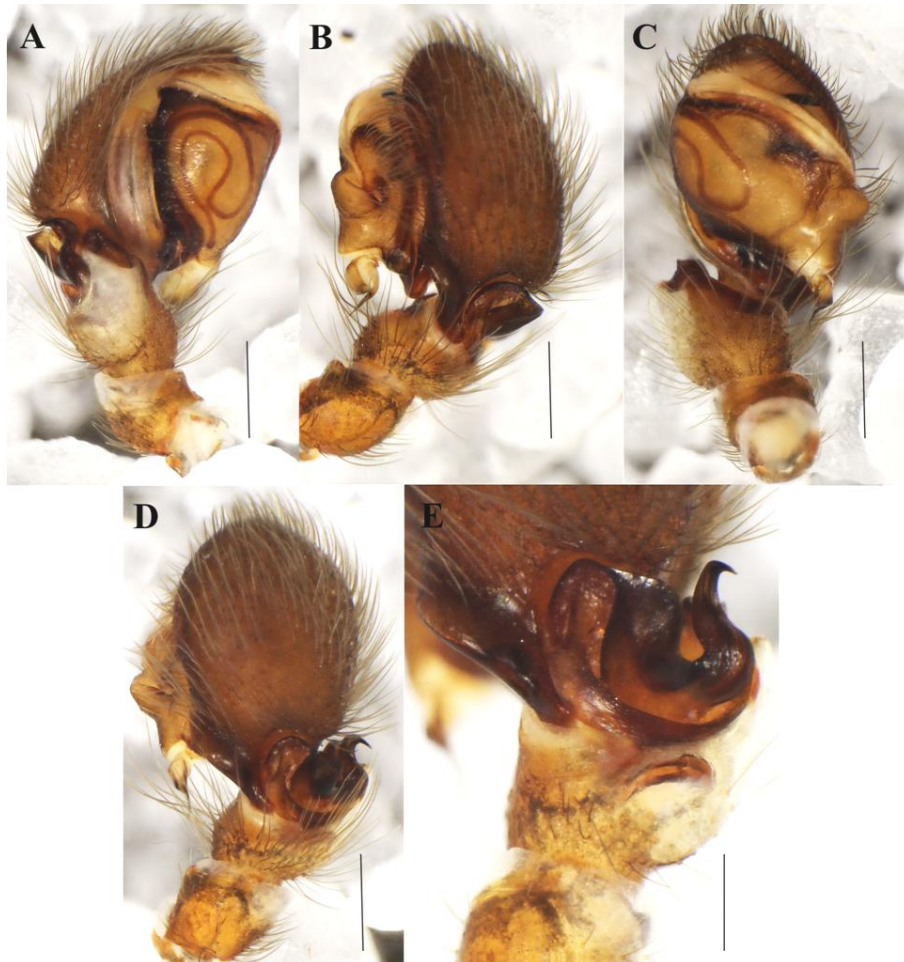


Fig. 3. *Titanoeca flavicoma* L. Koch, 1872, male, pedipalp. A-B. lateral view. C. ventral view. D. dorsal view. E. tibial apophyses complex, dorsal view. (Scale bar: 0.5 mm).

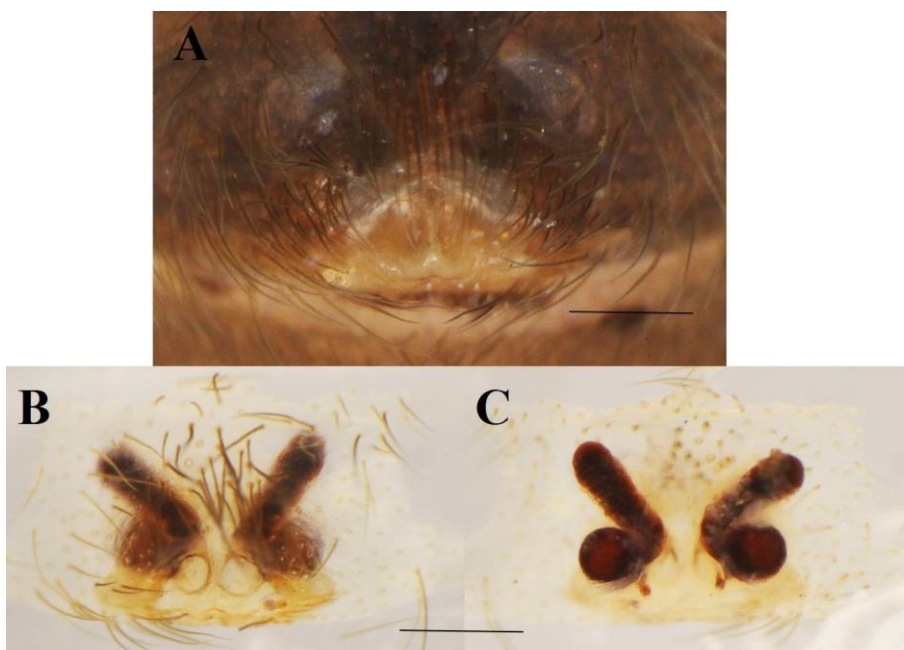


Fig. 4. *Titanoeca flavicoma* L. Koch, 1872, female, epigyne. A-B. ventral view. C. dorsal view. B-C. after maceration. (Scale bar: 0.5 mm).

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A new record of genus *Turkozelotes* from Türkiye (Araneae: Gnaphosidae)

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Abstract

A new record of genus *Turkozelotes* Kovblyuk & Seyyar, 2009, *Turkozelotes mccowani* (Chatzaki & Russell-Smith, 2017), is identified as a new record for the Turkish araneofauna. Its morphology is briefly described and illustrated.

Keywords: Araneae, Gnaphosidae, *Turkozelotes*, fauna, new record, Türkiye.

Introduction

Gnaphosidae is one of the most species-rich families of spiders, represented by 2474 species belonging to 153 genera worldwide (World Spider Catalog, 2024). There are 163 species in 34 gnaphosid genera listed for Türkiye (Danışman *et al.*, 2024). So far, only one species, *Turkozelotes microb* Kovblyuk & Seyyar, 2009, has been described in genus *Turkozelotes* (Kovblyuk *et al.*, 2009) from Türkiye. In the present study, *Turkozelotes mccowani* (Chatzaki & Russell-Smith, 2017) is recorded for the first time from Türkiye.

Material and Methods

Two specimens were collected by hand aspirator from Bayburt province (Eastern Black Sea Region) and preserved in 70% ethanol. SZX-16 Olympus stereomicroscope was used in identification. Examined specimens were deposited at Bayburt University, Bayburt, Türkiye (BAYU). Measurements are in millimetres. World distribution of the new record follows the World Spider Catalog (2024). Habitus and copulatory organs mainly compared with Chatzaki & Russell-Smith (2017) and Chatzaki (2018).

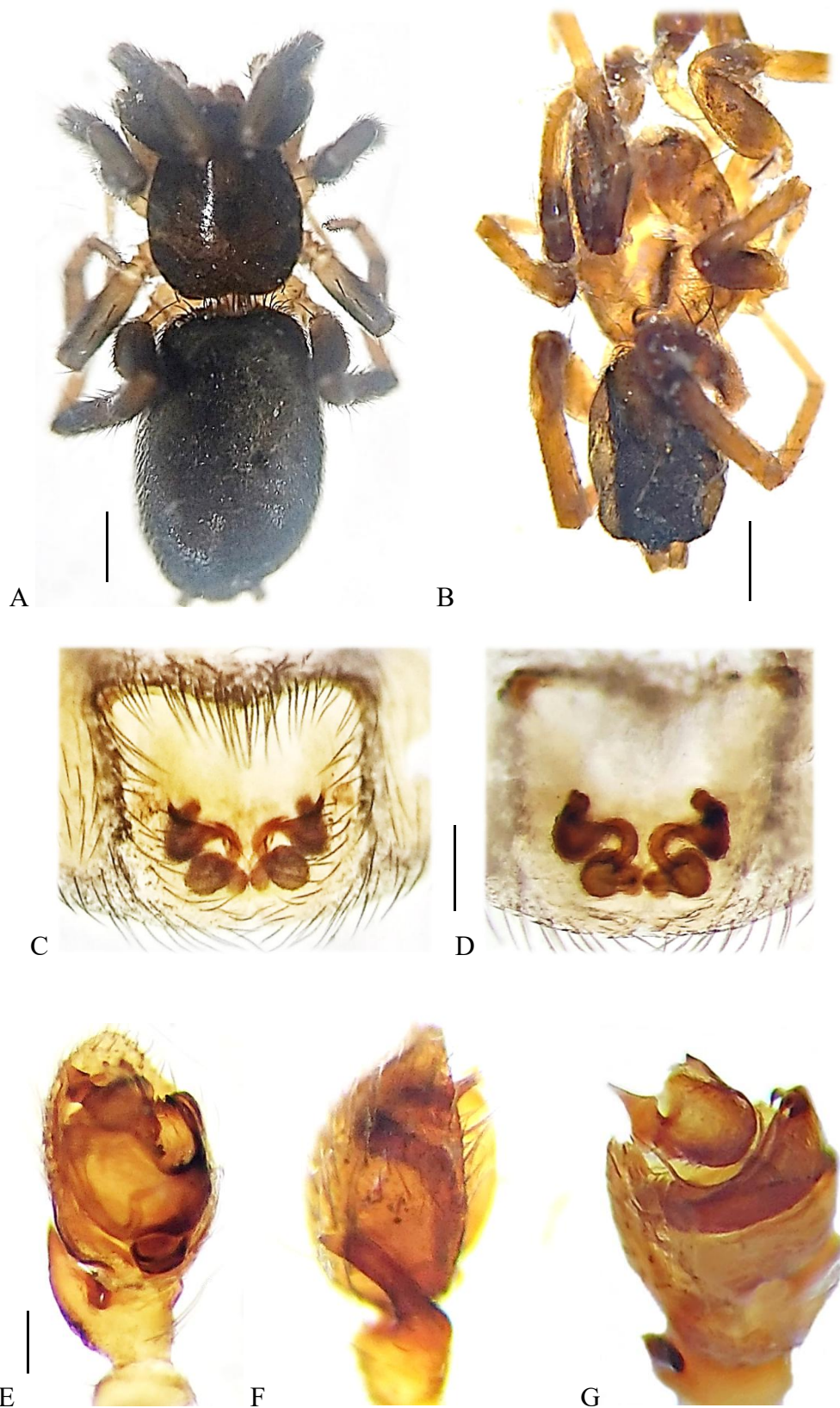


Fig. 1. *Turkozelotes mccowani* (Chatzaki & Russell-Smith, 2017), A-B. Habitus, dorsal view. A. Female. B. Male. C. Epigyne, ventral view. D. Vulva, dorsal view. E-G. Male pedipalp. E. ventral view. F. lateral view. G. Pedipalp without cymbium, dorsal view. (Scale bars: A-B. 0.5 mm, C-G. 0.1 mm).

Results

Turkozelotes mccowani (Chatzaki & Russell-Smith, 2017) (Fig. 1A-G)

Material examined: Türkiye, Bayburt Province, Bayburt University, Baberti Complex Campus Area (40°14'55.0"N, 40°10'49.3"E), 1650 m., 01.07.2023, 1♂; 15.07.2023, 1♀. Leg. N. Demircan Aksan.

Description: Female (Fig. 1A): Total length 3.6 mm. Carapace 1.3 long. Abdomen 2.3 mm long, Colouration: Carapace and abdomen dark brown. Legs brownish with dark brown femur, patella, and tibia. Epigyne, vulva, and spermathecae as in Fig. (1C-D).

Male (Fig. 1B): Total length 2.6 mm. Carapace 1.2 long. Abdomen 1.4 mm long, Colouration: Carapace light brown. Abdomen dark brown. Legs brownish with dark brown femur, patella, and tibia. Palp with long and dorsally oblique tibial apophysis (Fig. 1E-G).

Distribution: Bulgaria, Greece, Cyprus, Iran (World Spider Catalog, 2024) and Türkiye.

In this study, *Turkozelotes mccowani* (Chatzaki & Russell-Smith, 2017) is recorded for the first time from Türkiye. Therefore, the known species of the genus *Turkozelotes* is raised to 2 in Türkiye. The total number of species of family Gnaphosidae recorded from Türkiye is now 164 species.

Acknowledgment

This work was supported by The Scientific and Technological Research Council of Türkiye (TÜBİTAK) 2209-A Programme.

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New locality record of *Raveniola anadolu* Zonstein, Kunt & Yağmur, 2018 (Araneae: Nemesiidae) in Türkiye

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Abstract

Raveniola anadolu Zonstein, Kunt & Yağmur, 2018 is known from only one locality in Türkiye. In this study, we found this species in a new locality to expand its distribution in Anatolia. Its general habitus and male genitalia are illustrated.

Keywords: Spiders, *Raveniola anadolu*, new locality, Anatolia.

Introduction

Nemesiidae Simon, 1889 is a small family in Order Araneae and is currently represented by 157 species belonging to 10 genera in the world. The mygalomorph nemesiid spider genus *Raveniola* Zonstein, 1987 is currently known to comprise 45 species restricted to the south Palaearctic, chiefly to mountainous regions, and occurs from Türkiye to south China. Most species are local endemics and fairly evenly distributed through the range (World Spider Catalog, 2024). In Türkiye, there are 10 nemesiid spider species, 7 of which belong to the genus *Raveniola* (Danışman *et al.*, 2024).

The aim of this paper is to present a new locality record of the nemesiid spider *Raveniola anadolu* Zonstein, Kunt & Yağmur, 2018 in Türkiye. The new finding of this species widens its distribution in Türkiye (Fig. 1).

Material and Methods

In this study, two male specimens were collected from Mersin Province in southern Anatolia. Examined specimens were preserved in 70% ethanol and deposited in the Niğde Ömer Halisdemir University Arachnology Museum (NÖHUAM). For identification, Nentwig *et al.* (2024) and Zonstein *et al.* (2018) were consulted. The identification was made by means of a SZX61 Olympus stereomicroscope.



Fig 1. Localities of *Raveniola anatolia* Zonstein, Kunt & Yağmur, 2018 from Türkiye: new locality (Mersin Province), circle and old locality (Van Province), star.

Results

Raveniola anatolia Zonstein, Kunt & Yağmur, 2018 Figs. (2-3)

Collected specimens: 2♂♂, South of Türkiye: Mersin Province, Gülnar district, nearly 36°20'20"N, 33°23'55"E, 960 m, 15.X.2022, Leg. Osman Seyyar.



Fig. 2. *Raveniola anatolia* Zonstein, Kunt & Yağmur, 2018. A-B. Male habitus. A. dorsal view. B. ventral view.

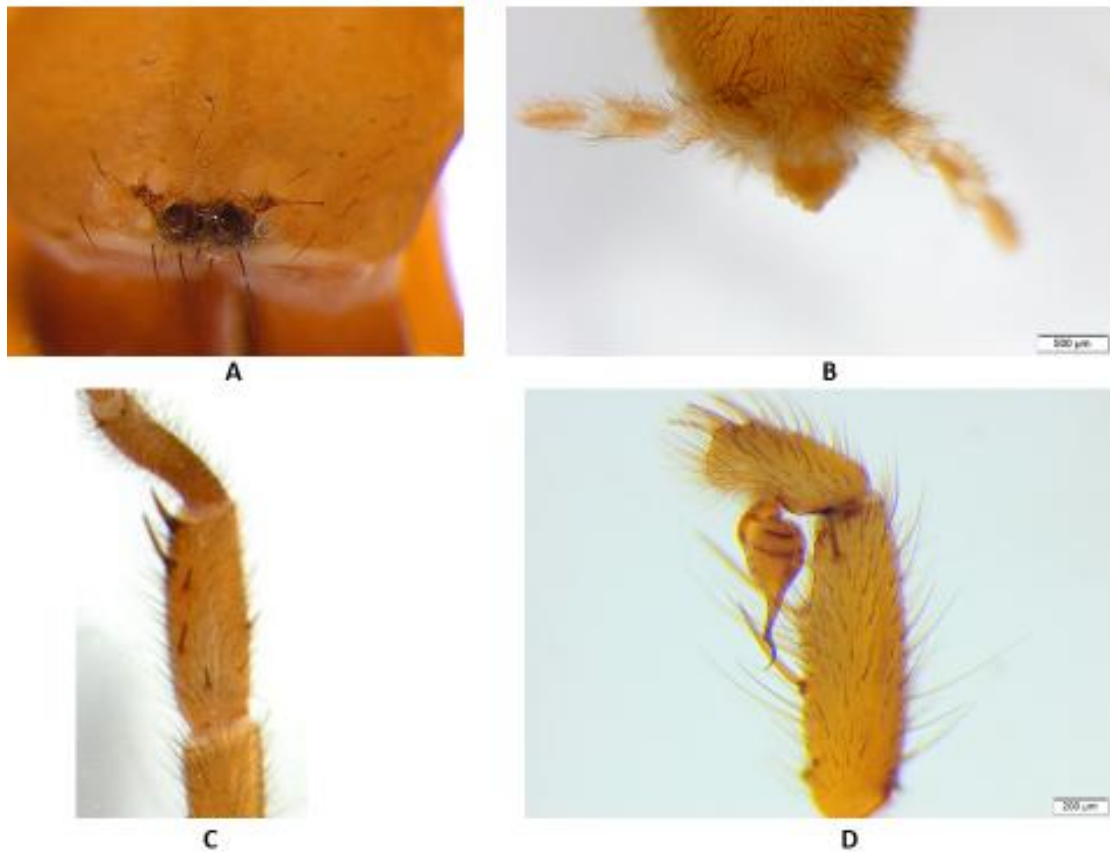


Fig. 3. *Raveniola anatoli* Zonstein, Kunt & Yağmur, 2018, Male. A. Ocular area, B. Spinnerets. C. Metatarsus I spines. D. Palp.

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Additional information on *Hersiliola bayrami* Danişman, Sancak, Erdek & Coşar, 2012 (Araneae: Hersiliidae) in Türkiye

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Abstract

Hersiliola bayrami Danişman, Sancak, Erdek & Coşar, 2012 is known from only one locality in Türkiye. In this study, we collect this species from new localities in southern Anatolia. Its general habitus and male genitalia are illustrated.

Keywords: Araneae, *Hersiliola bayrami*, new locality, Anatolia.

Introduction

Hersiliidae is a family of spiders mostly found in tropical and subtropical regions. These spiders are characterized by their long-slender legs and their exceptionally elongate spinnerets. It is a small family, currently including 188 species belonging to 16 genera (World Spider Catalog, 2024). In Türkiye, this family is represented only by genus *Hersiliola* Thorell, 1870. *Hersiliola* has only two species in the country (Danişman *et al.*, 2024). Species of *Hersiliola turcica* Marusik, Kunt & Yağmur, 2010 is distributed in south-east Anatolia (Marusik *et al.*, 2010) while the other species, *H. bayrami* Danişman, Sancak, Erdek & Coşar, 2012 is distributed in the Mediterranean region of Türkiye (Danişman *et al.*, 2012).

This study provides new data on the distribution of *H. bayrami* in Türkiye and expands the distribution area of the species (Fig. 1).

Material and Methods

In this study, three male specimens were collected from Mersin and Muğla Provinces in southern Anatolia. Examined specimens were preserved in 70% ethanol and deposited in the Niğde Ömer Halisdemir University Arachnology Museum (NÖHUAM). For identification, Danişman *et al.* (2012) was consulted. The identification was made by means of a SZX61 Olympus stereomicroscope.



Fig 1. Localities of *Hersiliola bayrami* Danişman, Sancak, Erdek & Coşar, 2012 from Türkiye: new locality (Mersin and Muğla Provinces), circles and old locality (Antalya Province), star.

Results

Hersiliola bayrami Danişman, Sancak, Erdek & Coşar, 2012 Figs. (2-3)

Collected specimens: 2♂♂, Türkiye: Mersin Province, Gülnar district, nearly 36°20'20"N, 33°23'55"E, 960 m, 05.VIII.2023, leg. Osman Seyyar; 1♂, Muğla Province, Dalaman District, nearly 36°46'N, 28°48'E, 15 m, 20.VIII.2023, leg. Osman Seyyar, found under stones.



Fig. 2. *Hersiliola bayrami* Danişman, Sancak, Erdek & Coşar, 2012, Male. A. Ocular area. B. habitus, dorsal view.

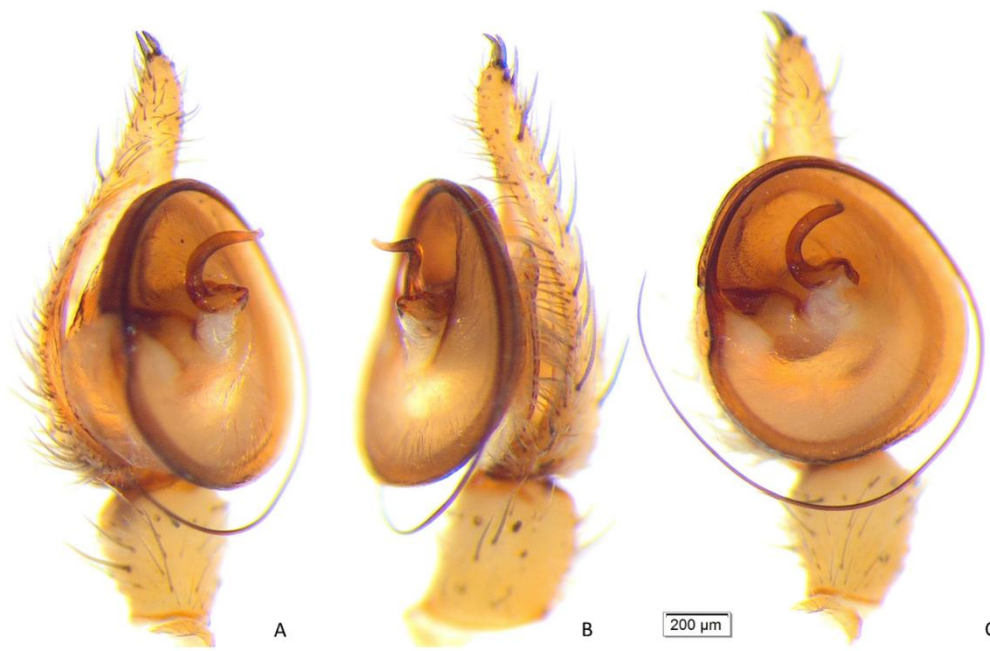


Fig. 3. *Hersiliola bayrami* Danişman, Sancak, Erdek & Coşar, 2012, Male palp. A. prolateral view. B. retrolateral view. C. ventral view.

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Two cases of malformation in the scorpion genus *Androctonus* Ehrenberg, 1828 from Central Algeria (Scorpiones: Buthidae)

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Abstract

This note concerns two cases of *Androctonus* species recently sampled from Ghardaïa region (Central Algeria). A remarkable malformation of one chela in *Androctonus amoreuxi* (Audouin, 1825) and a case of an enlargement of one chelicera in *Androctonus australis* (Linnaeus, 1758).

Keywords: Scorpion, Buthidae, Anomaly, pedipalps, chelicerae, Algeria.

Introduction

Scorpions have long been one of the taxa most susceptible to teratological anomalies (Polis, 1990). Remarkable morphological anomalies and teratological phenomena affect all parts of the scorpion body: metasoma, mesosoma, prosoma, pecten, pedipalp, telson, and chelicera (Dupré, 2023).

Abnormalities have been reported in many scorpion families. But, with a large number of cases in many genera of family Buthidae (Williams, 1971; Dupré & Legangueux, 1999; Karataş & Kürtüllü, 2006; Jahanifard *et al.*, 2008; de Sousa *et al.*, 2009; Lowe, 2010; Teruel & Rein, 2010; Galvis & Flórez-D., 2016; Salabi *et al.*, 2021; Sadine, 2021).

However, reports of anomalies in species of the genus *Androctonus* Ehrenberg, 1828 are relatively rare, particularly concerning the pedipalps and chelicerae. Most

documented cases involve the duplication of certain body parts and telson malformations (Sergent, 1942, 1946; Vachon, 1946, 1951; Millot & Vachon, 1949; Sadine, 2021). Only, a case of pedipalp duplication in *Androctonus crassicauda* (Olivier, 1807) has been reported (Karataş & Kürtüllü, 2006).

During the examination of *Androctonus* samples from Ghardaia region (Central Algeria) and raised under laboratory conditions, we detected two cases of malformation: an atrophied fixed finger of Chela in *A. amoreuxi* (Audouin, 1825) and an enlargement of one chelicera in *A. australis* (Linnaeus, 1758).

Material and Methods

The specimen of *Androctonus* species were collected from Ghardaia region (Central of Algeria) during 2022 to 2023. *A. amoreuxi* is the most abundant scorpion species in Ghardaia region (Sadine, 2018; Sadine *et al.*, 2023) and it is generally found on sandy, gravelly and stony grounds (Sadine *et al.*, 2018). *A. australis* is the most abundant and the most widespread species in the Algerian Sahara (Sadine, 2012; Sadine *et al.*, 2018, 2020, 2023). The two *Androctonus* examined are females deposited in the Laboratory of Zoology, University of Ghardaia, Algeria. Identification was obtained using a stereo-microscope as described by Vachon (1974).

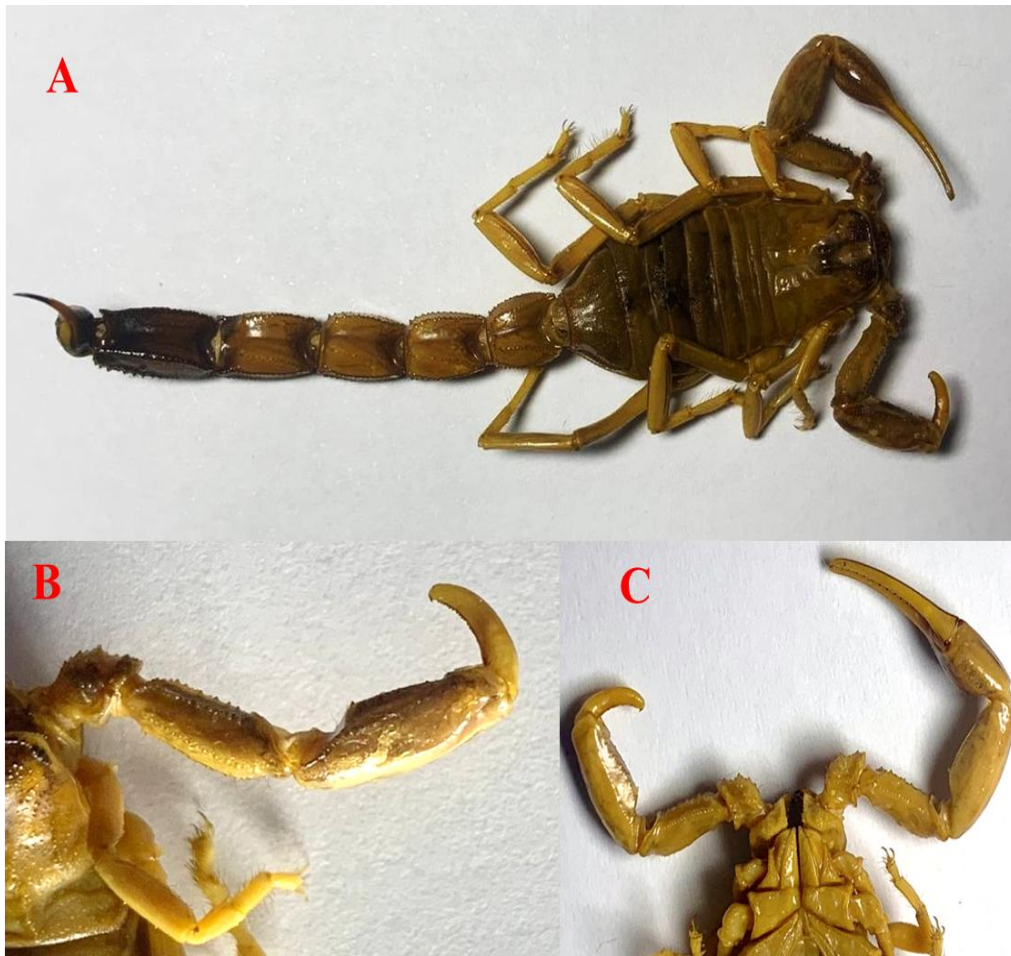


Fig. 1. *Androctonus amoreuxi*, female. A. Habitus. B. the right pedipalp in dorsal view shows atrophied fixed finger. C. the right pedipalp in ventral view shows total disappearance of mobile finger.

Results and Discussion

The results concern the two cases of malformation in *Androctonus* species are detailed as follows:

1. *Androctonus amoreuxi*

This female was found in its natural biotope, with a remarkable malformation of the right chela (Fig. 1A) with atrophied fixed finger (4.33 mm Vs 15.22 mm) and total disappearance of mobile finger (Fig. 1B-C). Morphometric analyses of different parts of the pedipalps are summarized in Table (1).

Table 1. Measurements values (in mm) of different pedipalps of the studied female *Androctonus amoreuxi*.

| | Left Pedipalp | Right Pedipalp |
|-----------------------|---------------|----------------|
| Femur Length | 5,41 | 5,39 |
| Femur Width | 2,78 | 2,73 |
| Patella Length | 8,19 | 8,12 |
| Patella Width | 3,83 | 3,76 |
| Chela | 15,22 | 4,33 |
| fixed finger | 14,87 | --- |

2. *Androctonus australis*

This female was found in its natural biotope, with a normal body, only a malformation (enlargement) in the right chelicera (Fig. 2) of which it was positioned outside the right side of the cephalothorax (next to the lateral eyes).

We noted here that this species was naturally strongly attacked by an external mite *Pimeliaphilus* sp. (Acari: Prostigmata: Pterygosomatidae).



Fig. 2. *Androctonus australis*, female showing enlargement of right chelicera.

In scorpions as in many other arthropod groups, morphological abnormalities are common and have been documented in various regions of the body (Alqahtani & Badry, 2021). This type of malformation in the pedipalps and chelicerae is reported in several arthropods, such as spiders (Foelix, 2011) and in crustaceans like crabs and lobsters (Hartnoll, 1974).

The causes of malformations in scorpions remain unknown (Mattoni, 2005; Salabi *et al.*, 2021). Some studies on other arthropods report that several factors may contribute to these malformations such as: the genetic factors by chromosomal disorder, gene defects and mutations (Poswillo, 1976) and the environmental factors humidity, temperature and various chemical compounds which can influence the embryonic development (Li, 1995; Li & Jackson, 1996; Buczek, 2000; Napiorkowska & Templin, 2013).

These morphological anomalies can have a significant influence on various aspects of these small arthropods life, in particular their feeding and reproductive behaviour. In terms of feeding behavior, these malformations tend to reduce the scorpions' hunting and defence capabilities. As for reproductive behaviour, they tend to reduce reproductive success and the fertility rate of individuals (Polis, 1990).

In this context, the malformations of the pedipalps in *A. amoreuxi* could pose a problem in prey hunting, as these pedipalps with two fingers are a valuable resource for capturing, handling and securing prey. Furthermore, it is important to note that the pedipalps play an essential role in courtship rituals and mating. Consequently, the malformations observed could indirectly disrupt the ability of males and females to display effective sexual behaviour, which could compromise the chances of successful reproduction.

However, the malformation of the chelicerae in *A. australis* may have significant consequences for the scorpion's survival. In effect, these anomalies could prevent the animal from effectively tearing its prey. Consequently, the scorpion's ability to feed properly could be seriously compromised, with a major impact on its survival.

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The first record of the spider *Segestria florentina* (Rossi, 1790) (Araneae: Segestriidae) in Libya

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Abstract

The genus *Segestria* Latreille, 1804 and the species *Segestria florentina* (Rossi, 1790) are recorded in Libya for the first time, based on a single adult female specimen.

Keywords: Araneae, Segestriidae, *Segestria florentina*, first record, Libya.

Introduction

Segestriidae Simon, 1893 is a spider family with 179 recorded species and five genera, with the second largest of which is *Segestria* Latreille, 1804, with 21 species and 1 subspecies. *Segestria* is distributed in Asia, Europe, Madagascar, Mediterranean, New Zealand, Northern Africa, North and South America (El-Hennawy, 2020a; World Spider Catalog, 2024). Segestriidae is characterized as medium-sized (tube web) cribellate, haplogyne, araneomorph spiders; with three tarsal claws, six eyes and third pair of legs directed anteriorly; posterior tracheal spiracles far in front, just behind booklung slits; female palpal claw turned inwards over almost 90° (Jocqué & Dippenaar-Schoeman, 2006). Of the family Segestriidae, only one species is recorded in Libya, *Ariadna insidiatrix* Savigny, 1825 (Nentwig *et al.*, 2024). The majority of segestriids, including *Segestria florentina* (Rossi, 1790), inhabit wide range of environments, although they prefer to live in cracks or fissures found in the walls or barks or beneath rocks, where

they can build a tubular hideaway with robust silk strands stretching from the exit (entrance) (Roberts, 1995; Zamani, 2014).

So far, 310 spider species of 37 families have been recorded in Libya (Nentwig *et al.*, 2024). To the time of writing this work the species *Segestria florentina* (Rossi, 1790) has not been recorded yet from Libya.

Material and Methods

One adult female specimen was encountered accidentally at night (9 pm on 13th December 2023) in Badrten village, Gharyan city (mountainous city, 750 m above sea level and 105 kilometres south of Tripoli). While the spider was wandering on patio floor of farm house (the farm was containing palm, grape and olive trees), it was collected by hand, using metal box, and kept alive in a glass jar with perforated cover for some time before being preserved in 75% alcohol. Examination was conducted at laboratory of Biology department, faculty of education (Souq Al Jum'aa), University of Tripoli using Wild M3 (Heerbrugg) dissecting stereomicroscope and photos were taken with Omax A35180U3 mounted microscope digital camera. All measurements are presented in millimetres. The following abbreviations are used: AL = abdomen length, CL = cephalothorax length, CW = cephalothorax width, TL = total length.



Fig.1. First distribution map of *Segestria florentina* (Rossi, 1790) in Libya. Red sign [Badrten village, Gharyan city, 105 km south of Tripoli].

Taxonomy

Family **Segestriidae** Simon, 1893

Genus ***Segestria*** Latreille, 1804

Diagnosis: with 21 species and 1 subspecies, this genus is the second largest of Segestriidae, distributed mainly in Asia, Europe and north Africa (World Spider Catalog,



Figs. 2-7. *Segestria florentina* (Rossi, 1790), ♀. 2-3. Habitus. 2. dorsal view. 3. lateral view. 4. frontal view showing green iridescent chelicerae and eyes. 5. Prosoma, ventral view, showing sternum, labium and endites. 6. Spinnerets. 7. Abdomen (underside) showing epigyne.

2024). The species of *Segestria* resemble those of *Ariadna* Savigny, 1825 and *Gippsicola* Hogg, 1900, but have some defining features: three anterior and two posterior triangular cheliceral teeth, thin, extended, and nearly parallel sided labium, the female has many spines on leg IV and two ventral rows of long, thin spines on tibiae and metatarsi I-II (Giroti & Brescovit, 2011). Moreover, *Segestria* species have their median eyes and posterior lateral eyes on a strongly recurved line compared to a nearly straight line of their counterparts in *Ariadna* species (Nentwig *et al.*, 2024).

***Segestria florentina* (Rossi, 1790)**

For detailed list of synonyms, see World Spider Catalog (2024).

Material examined: 1♀, Libya: Al Jabal Al Gharbi District, Gharyan City, Badrten Village, (32°09'18.0"N, 13°03'28.8"E, altitude 750 m), 13th December 2023, found at night while the spider was wandering on patio floor of farm house (Fig. 1).

Description: Female (Figs. 2-7). TL 15.1, CL 8.7, CW 4.93, AL 6.4. Carapace dark orange to brown, darker laterally and at eye area. Chelicerae are with green iridescent shine. Carapace elevated (convex) when viewed from lateral side. The dorsal side of abdomen has dark gray to brown connected lobes in the mid line, absent ventrally. Sternum and legs relatively light orange brown.

Diagnosis: *Segestria florentina* (Green-fanged Tube web spider) can be distinguished from its closely related species by the presence of green, iridescent chelicerae in female (Roberts, 1995; Bee *et al.*, 2020), while the male palpal organs have short blunt embolic tips of the palpal bulbs (Roberts, 1995; Giroti & Brescovit, 2011). Moreover, chelicerae have three promarginal (anterior) and two retromarginal (posterior) triangular teeth when viewed ventrally (Giroti & Brescovit, 2011; El-Hennawy, 2020b).

Global distribution: Europe, North Africa, Jordan, Turkey, Ukraine, Russia, Georgia. Introduced to Brazil, Uruguay, Argentina (World Spider Catalog, 2024). More detail: Algeria, Andorra, Belgium, Bulgaria, Croatia, Cyprus, Egypt, France (Corsica), Georgia, Germany, Greece/Crete, Hungary, Ireland, Italy (Sardinia, Sicily), Jordan, Montenegro, Morocco, Netherlands, North Macedonia, Portugal, Romania, Russia/Southern, Serbia, Slovakia, Slovenia, Spain, Balearic Islands, Switzerland, Tunisia, Turkey (Asia), Ukraine, United Kingdom (Nentwig *et al.*, 2024).

Discussion

Although this spider species is mainly found in the Mediterranean, it has been reported far from this habitat (e.g. Germany, Netherlands, as far east as Georgia and as far north as Britain) (Nolan, 2008). The species is commonly found within cargo such as banana boxes (Nolan, 2008) or building materials (Helsdingen, 2008). There must be breaks in the walls of buildings or slits between the walls the window-frame, because *Segestria florentina* does not usually benefit from modern construction methods; however, it can still find its way in the ventilation slits (Helsdingen, 2008).

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**First record of the genus *Larinioides* Caporiacco, 1934
(Araneae: Araneidae) from Eastern Hammar Marsh,
Basrah Province, southern Iraq**

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Abstract

The genus *Larinioides* Caporiacco, 1934 is recorded in Iraq for the first time. Males and females of *Larinioides suspicax* (O. Pickard-Cambridge, 1876) were collected from eastern Hammar marsh, Basrah Province, south of Iraq. Illustrations of palps and epigyne of the species, and a map of the specimens collecting location are provided.

Keywords: *Larinioides*, furrow spider, marsh, Basrah, Iraq.

Introduction

Family Araneidae currently includes 3132 species within 191 genera, and there are 7 species belonging to the genus *Larinioides* Caporiacco, 1934 (World Spider Catalog, 2024).

Larinioides species, previously treated as a subgroup of genus *Araneus*, were placed in genus *Nuctenea* Simon, 1864, a genus that was validated by Levi (1974), and Grasshoff (1983) subsequently indicated that the correct name for the so-called *Araneus cornutus* group was *Larinioides*, and returned *Nuctenea cornuta* to *Larinioides suspicax* (Levy, 1998).

In the world, only 7 species of the genus *Larinioides* are recorded: *L. chabarovi* (Bakhvalov, 1981), *L. cornutus* (Clerck, 1757), *L. ixobolus* (Thorell, 1873), *L. jalimovi* (Bakhvalov, 1981), *L. patagiatus* (Clerck, 1757), *L. sclopetarius* (Clerck, 1757) and *L. suspicax* (O. Pickard-Cambridge, 1876) (Šestáková *et al.*, 2014; Morano, 2023).

L. suspicax has been recorded in neighbouring countries of Iraq in Türkiye (Danışman *et al.*, 2024) and Iran (Šestáková *et al.*, 2014).
The aim of the present study is to provide new data on the fauna of spiders in Iraq.

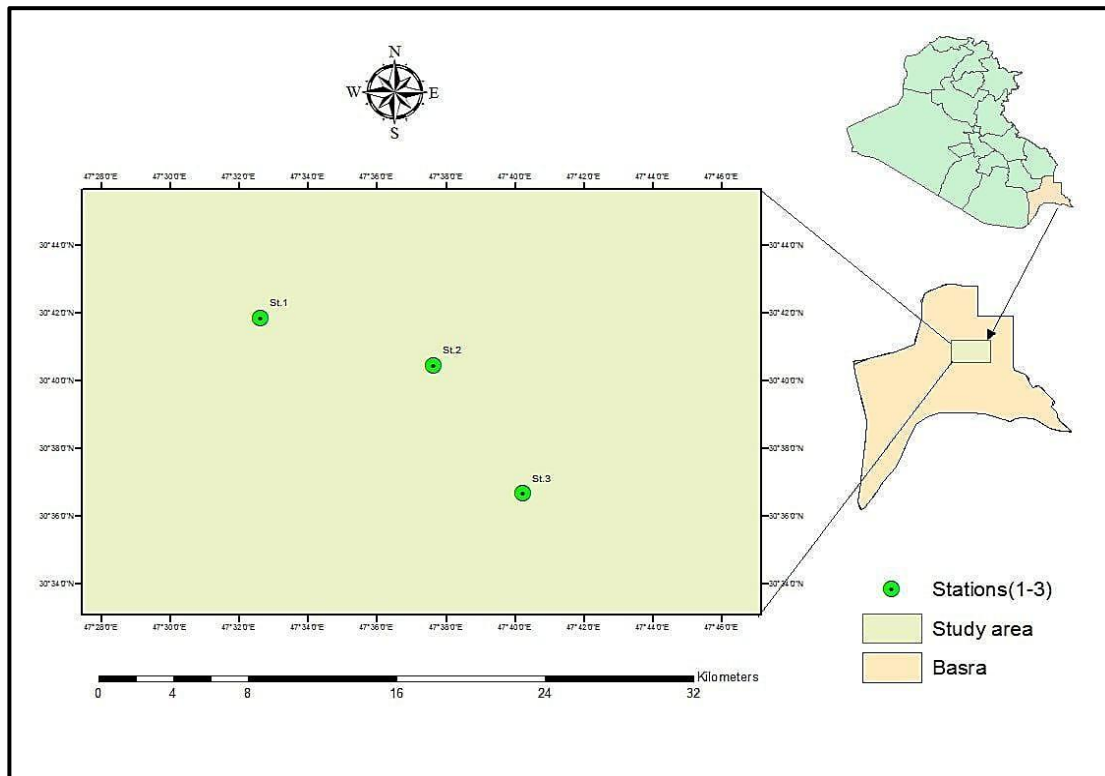


Fig. 1. Map of collecting location of *Larinioides suspicax* (O. Pickard-Cambridge, 1876) in Eastern Hammar marsh, Basrah Province, Iraq.



Fig. 2. *Larinioides suspicax* (O. Pickard-Cambridge, 1876) in Eastern Hammar marsh. A. Habitat. B. the retreat on plant leaf.

Material and Methods

The study was conducted in Eastern Hammar marsh, Basrah Province, south of Iraq from three stations (Fig. 1). Specimens were collected using active collecting method and sweep nets from *Phragmites australis* and *Typha domingensis* plants. The specimens were identified in the laboratory of Department of Ecology, College of Science, University of Basrah using Leica EZ 4HD stereomicroscope. Identification references were: Morano (2002) and Šestáková *et al.* (2014).

The photos were taken by Sony a7rIV camera, with canon MP-E 65 mm f/2.8 1-5x macro lens attached to Krüss stereomicroscope, then digital images were montaged using the software Helicon Focus™ 8.1.0.

Taxonomy

Family **Araneidae** Clerck, 1757

Genus ***Larinioides*** Caporiacco, 1934

L. suspicax (O. Pickard-Cambridge, 1876) (Figs. 3-5)

L. suspicax Morano, 2002: 71, f. 4A-B (♂♀).

L. folium Šestáková, Marusik & Omelko, 2014: 78, f. 7A-D, 8G, 9G, 15A-D, 16A-D, 25B, 31C-D (♂♀).

L. suspicax Morano, 2023: 94, f. 88A-B (♀).

For full taxonomic references see World Spider Catalog (2024).

Material Examined. 5♂♂, 13♀♀, Eastern Al-Hammar marsh, Basrah Province, south of Iraq, (Al-Barga: 30.6977033N, 47.5434597E), (Al-Mansori: 30.6744553N, 47.62722335E), (Al-Sadda: 30.6113804N, 47.6709991E), December 2022 to January 2023, Leg. Shurooq A. Najim.

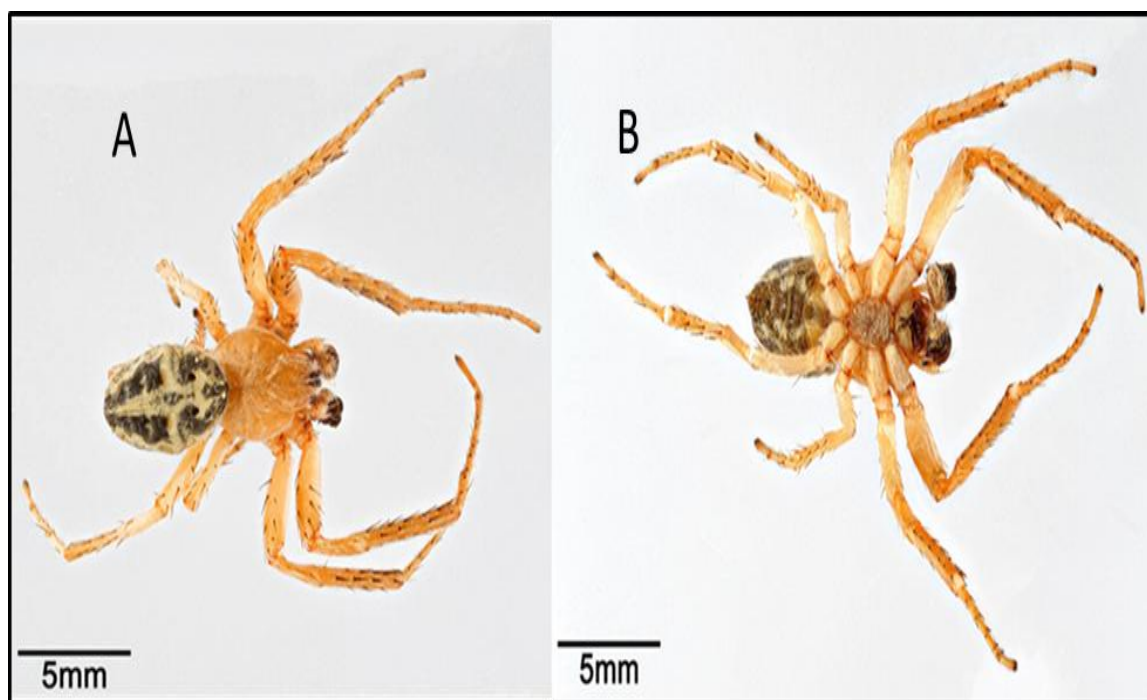


Fig. 3. *Larinioides suspicax* (O. Pickard-Cambridge, 1876) ♂, habitus. A. dorsal view. B. ventral view.

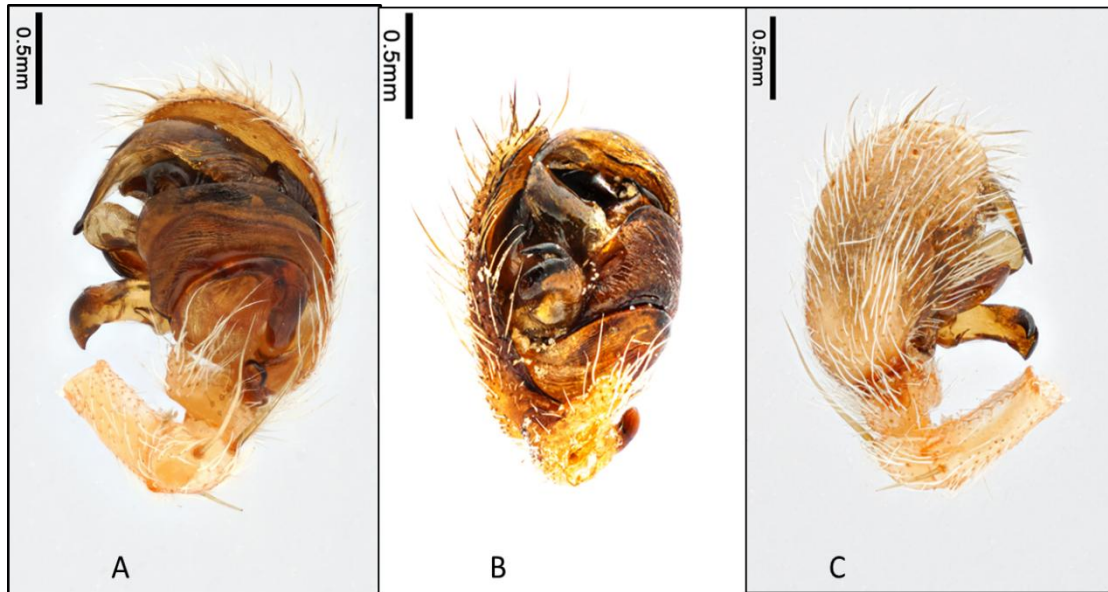


Fig. 4. *Larinioides suspicax* (O. Pickard-Cambridge, 1876) ♂, palp. A. prolateral view. B. ventral view. C. retrolateral view.

Diagnosis. The notable feature in *Larinioides* males that differentiates them from all other araneid genera is the existence of one armed median apophysis bipartite tip (Šestáková *et al.*, 2014). Females have a short flexible scapus and the median plate of the epigyne is not so protruding, with a raised folded margin forming lateral lamella.

Description. Male. Total length 7.4 mm (Figs. 3A-B). Prosoma (length 3.1 mm, width 3.8 mm) uniformly brown covered by pale setae. Cephalic area protruding. Legs: yellow to brown, distal rim of 1st coxa with ventral hook. Opisthosoma (length 4.3 mm, width 3.6 mm). Pedipalp (3.2 mm), patella with two macrosetae (Fig. 4A); median apophysis with flat rounded lower part and narrow upper one with a pointed tip (Figs. 4B-C), median apophysis curved viewed from the side pointed towards the base of palp; terminal apophysis long and pointed, subterminal apophysis 1 rounded, subterminal apophysis 2 toothed; conductor rounded (Fig. 4B) and weakly sclerotized, simple with a widened distal end.

Females resemble males in external appearance except that they are slightly larger in size. Epigyne as in Figs. (5A-B). Scapus short and straight; median plate anteriorly squared, surrounded by lateral lamellae, anteriorly folded into triangular lobes covering copulatory openings, basal lamellae well developed.

Comments

L. suspicax is widespread in Europe, North Africa to Central Asia (World Spider Catalog, 2024). The specimens of this species are typically found near water bodies and riversides, all males and females are found inside a retreat (Fig. 2) of web during the daytime.

L. suspicax is very similar to *L. cornutus*, but it differs by its anterior fork end of the median apophysis which ends in a point, and the subterminal apophysis which is strongly developed, with a jagged free edge, while the anterior fork end of *L. cornutus* is characterized by its round shape and the subterminal apophysis not jagged (Thaler, 1974).

The female of *L. suspicax* is characterized by a square-shaped epigyne, which is rounded in *L. cornutus*.

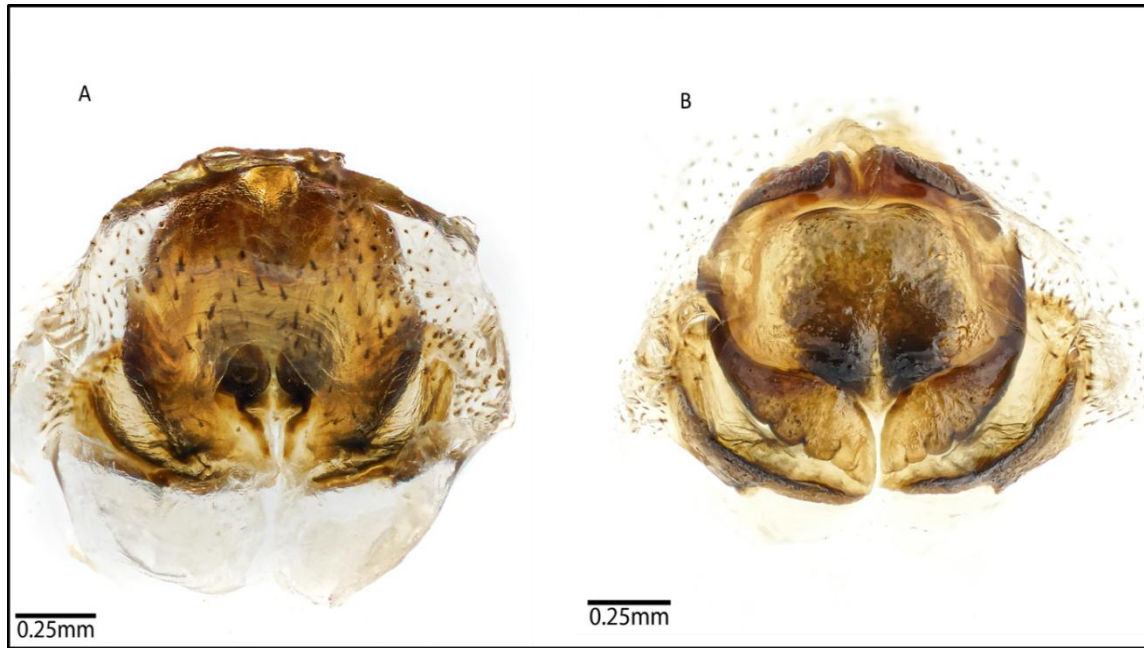


Fig. 5. *Larinioides suspicax* (O. Pickard-Cambridge, 1876) ♀, epigyne. A. ventral view. B. vulva, dorsal view.

Acknowledgment

We are grateful to Hisham K. El-Hennawy for critical commenting of the draft manuscript.

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Two new records of gnaphosid spiders (Araneae: Gnaphosidae) from Eastern Al-Hammar marsh south of Iraq

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Abstract

The genus *Cryptodrassus* Miller, 1943 and *Zelotes laetus* (O. Pickard-Cambridge, 1872), are recorded for the first time from Eastern AL-Hammar marsh, Basra province south of Iraq. Males of *Zelotes laetus* (O. Pickard-Cambridge, 1872) and females of *Cryptodrassus helvolus* (O. Pickard-Cambridge, 1872) were identified and photographed. Illustrations of palp and epigyne of the species and the map of specimens collecting location are provided.

Keywords: *Zelotes*, *Cryptodrassus*, gnaphosidae, marsh, Al-Hammar, Iraq.

Introduction

The family Gnaphosidae Pocock 1898, commonly known as ground spiders, inhabit a wide range of habitats around the world. It is a large diverse group represented by 153 genera and 2475 described species (World Spider Catalog, 2024). Most members of family Gnaphosidae are free-living ground-dwelling spiders typically found on the surface or within crevices (Jocqué & Dippenaar-Schoeman, 2006).

The distinctive characters of spiders belong to this family include specimens with the anterior spinnerets bearing greatly enlarged and widened piriform gland spigots and with the posterior median eyes conspicuously flattened or irregular in shape (Platnick, 1990).

While studying the fauna spiders of Eastern Al-Hammar marsh, two species which belong to genus *Cryptodrassus* Miller, 1943 and *Zelotes* Gistel, 1848: *Cryptodrassus helvolus* (O. Pickard-Cambridge, 1872) and *Zelotes laetus* (O. Pickard-

Cambridge, 1872) have been recorded for the first time in Iraq.

Both species were spread in neighbouring countries, *C. helvolus* from Iran (Hosseinpour *et al.*, 2019) and *Z. laetus* from Iran (Zamani *et al.*, 2022) and Türkiye (Danışman & Erol, 2022).

The aim of the study is to provide new data of spiders from Iraqi marshes.

Material and Methods

The current study was conducted at Eastern Al-Hammar marsh, Basrah province south of Iraq. The specimens were collected during day time by hand and aspirator collecting methods, from three stations: Al-Manthouri, Al-Mansouri, and Al-Sadda (Fig. 1).

The specimens were preserved in 80% ethyl alcohol and identified in the laboratory of Department of Ecology, College of Science, University of Basrah using Leica EZ 4HD stereomicroscope and deposited in Natural History Museum of Basrah University.

Epigyne and pedipalp were set on slides with a drop of ethyl alcohol each and photographed by Sony a7rIV camera, with canon MP-E 65mm f/2.8 1-5x macro lens attached to Krüss stereomicroscope, then digital images were montaged using software Helicon Focus™ 8.1.0. All measurements are in millimetres.

Abbreviations used: ALE = anterior lateral eye, AME = anterior median eye, PLE = posterior lateral eye, PME = posterior median eye.

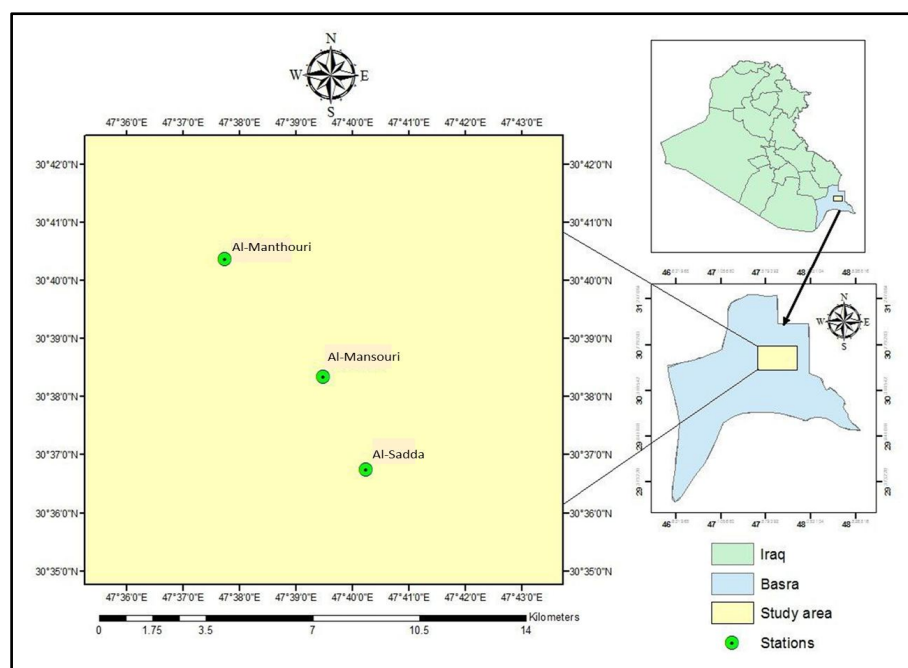


Fig. 1. Map of collecting stations (Al-Manthouri, Al-Mansouri, and Al-Sadda), Eastern Al-Hammar marsh, Basrah Province, Iraq.

Results

Taxonomy

Family Gnaphosidae

Genus *Cryptodrassus* Miller, 1943

Cryptodrassus helvolus (O. Pickard-Cambridge, 1872)

Taxonomic references

Zelotes helvoloides: Levy, 1998: 150, figs. 126-127 (♀).

Cryptodrassus helvolus: Chatzaki & Russell-Smith, 2017: 238, figs. 1-6 (♂♀); Ponomarev *et al.*, 2018: 246, figs. 3-4 (♀).

Material Examined: 4♀♀, Eastern Al-Hammar marsh, Basrah Province, south of Iraq, Al-Mansouri: 30°38'20.460"N, 47°39'29.670"E; Al-Sadda: 30°36'45.221"N, 47°40'14.832"E. June 2023. Leg Shurooq A. Najim.



Fig. 2. *Cryptodrassus helvolus* (O. Pickard-Cambridge, 1872) ♀. A-B. Habitus. A. dorsal view. B. ventral view.

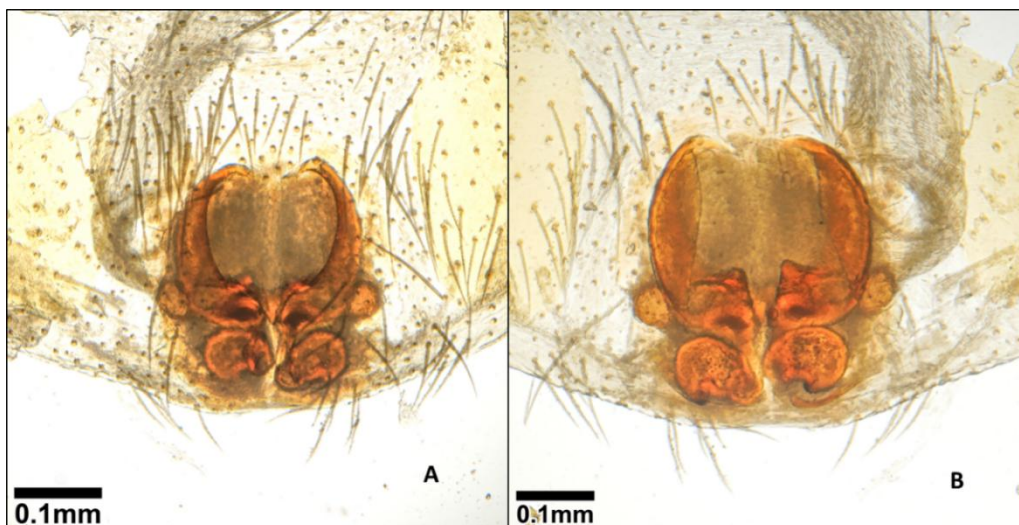


Fig. 3. *Cryptodrassus helvolus* (O. Pickard-Cambridge, 1872) ♀. A. Epigyne, ventral view. B. Vulva, dorsal view.

Description: female (Fig. 2A-B). Total length 3.90-3.93. Prosoma pale brown coloured, with short fovea, length 1.85-1.87, width 1.43-1.45. Abdomen light grey, hairy, length 2.02-2.04, width 1.41-1.42. Chelicerae light brown with three promarginal and two retromarginal teeth. AME almost touching ALE; PME largest, subequal to AME; eye diameter: AME 0.056-0.058, ALE 0.040-0.042, PME 0.065-0.067, PLE 0.013-0.014. Legs pale brown. Epigyne with round median cavity partly surrounded by fine brown rim along, anterior hood is absence (Fig. 3A), vulva as in Fig. (3B).

Genus *Zelotes* Gistel, 1848

Zelotes laetus (O. Pickard-Cambridge, 1872)

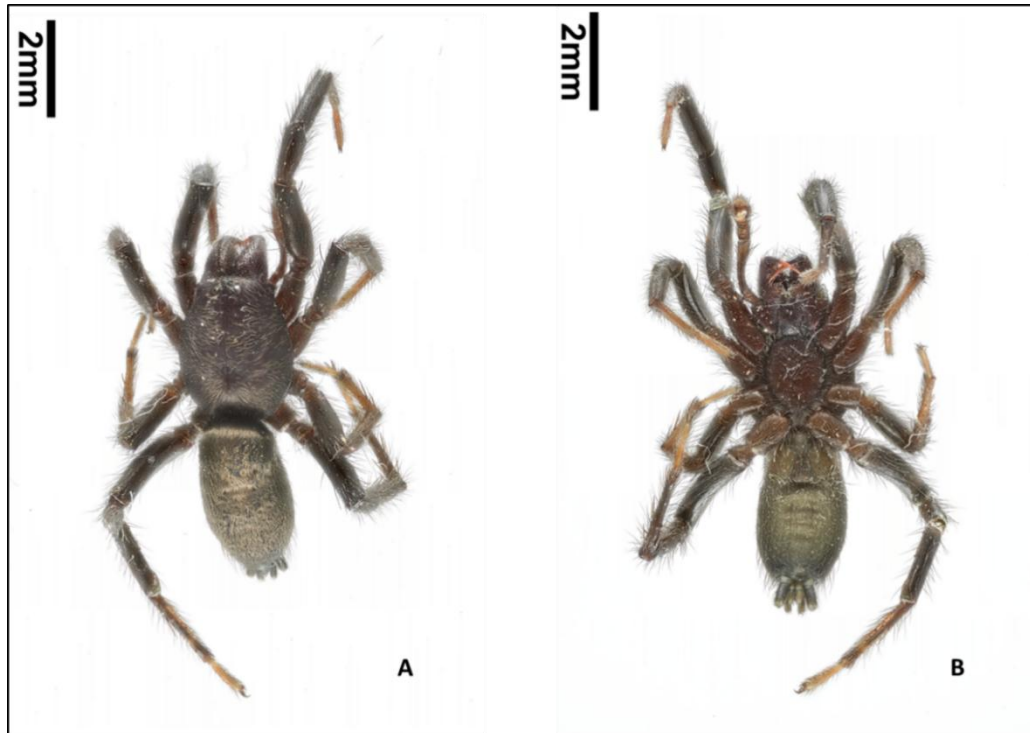


Fig. 4. *Zelotes laetus* (O. Pickard-Cambridge, 1872) ♂. A-B. Habitus. A. dorsal view. B. ventral view.

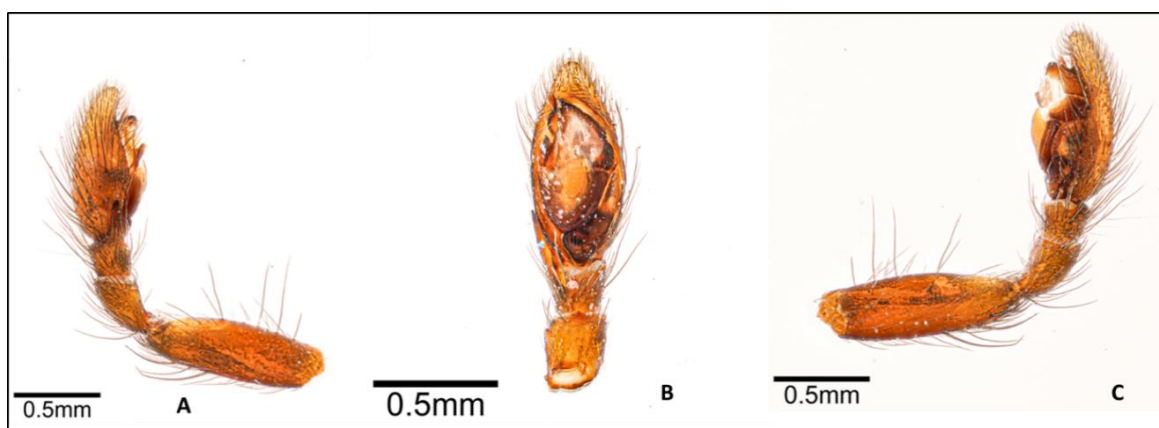


Fig. 5. *Zelotes laetus* (O. Pickard-Cambridge, 1872) ♂. A-C. Right pedipalp. A. retrolateral view. B. ventral view. C. prolateral view.

Taxonomic references

Zelotes reformans Platnick & Shadab, 1983a: 182, f. 253-258 (♂♀).

Zelotes laetus Levy, 1998: 122, f. 58-61 (♂♀); FitzPatrick, 2007: 108, f. 21-24 (♂♀);

Zamani *et al.*, 2022: 361, f. 11-13 (♂); Abdel-Ghani *et al.*, 2023: 33, f. 11a-b (♂♀).

Material Examined: 3♂♂, Eastern Al-Hammar marsh, Basrah province, south of Iraq, Al-Manthouri: 30°40'22.389"N, 47°37'45.361"E. September, 2023. Leg Shurooq A. Najim.

Description: Male (Fig. 4A-B). Total length 6.1-6.3. Prosoma dark brown with black setae, length 2.6-2.8, width 2-2.2. Sternum light brown. Chelicerae long, brown, dorsally with long setae. Abdomen blackish grey dorsally with short setae, length 3.4-3.5, width 1.6-1.7. Legs dark brown except metatarsus and tarsus with yellow colour, 3rd and 4th metatarsus have preening comb. Spinnerets grey.

Pedipalp: bulb elongate and slender, with intercalary sclerite, embolus is elongated and filamentous, median apophysis extend apically, tibial apophysis straight (Fig. 5A-C).

Discussion

Genus *Cryptodrassus* Miller, 1943 includes 11 species from Asia and Europe (World Spider Catalog, 2024). This is the first record of *Cryptodrassus* from Iraq. The main distinctive characters of the genus are: small size and pale body colouration, posterior median eyes largest and oval, all other round, large number of trichobothria on tibia, metatarsus and tarsus, preening comb on metatarsi III and IV (Chatzaki & Russell-Smith, 2017).

The species *Cryptodrassus helvolus* is widespread in Russia (Europe), Türkiye, Cyprus, Israel, Iran, Kazakhstan (Hosseinpour *et al.*, 2019; World Spider Catalog, 2024). Levy (1998) presented a brief description of female under the name *Zelotes helvoloides* and Chatzaki & Russell-Smith (2017) transferred it to *Cryptodrassus helvolus*.

Genus *Zelotes* is characterized by the presence of preening combs on metatarsi III and IV; two eye patterns occur: either eyes are small with anterior median eyes usually smaller than other subequal eyes, separated by roughly their diameter, and by less than their radius from anterior lateral eyes; or eyes are relatively larger, closely grouped, with posterior median eyes the largest. The male palp has an intercalary sclerite, a simple ledge-shaped terminal apophysis (sometimes fused dorsally to the embolar base), a large embolar base (bearing projection and curved embolus), median apophysis and membranous conductor, the epigyne is variable often with pair of blind paramedian ducts (Platnick & Shadab, 1983).

To date, there are three species that belong to genus *Zelotes* have been recorded from Iraq *Z. jakesi* Zamani & Marusik, 2022 (Zamani & Marusik, 2022), *Z. subterraneus* (C. L. Koch, 1833) (Al-Yacoub & Al-Abbad, 2022), and *Z. fagei* Denis, 1955 (Zamani *et al.*, 2022); this is the first record of the species *Zelotes laetus* from Iraq.

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Composition and structure of spider community in house gardens of Amravati, Maharashtra, India

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Abstract

Though house gardens are essential for biodiversity conservation studies, few surveys exist, so documenting different life-form entities seems indispensable. This recognition needs to be backed by surveys from various house gardens. A six-month preliminary study was conducted from July 2021 to December 2021, comprising 12 surveys twice a month at each selected house garden with mixed cropping incorporating vegetables, fruits, plantation crops, spices, herbs, and ornamental as well as medicinal plants. Around 2765 specimens from 44 genera belonging to 16 families were registered. The survey confirms the role of house gardens in diversity conservation and spiders as predators. Araneids, lycosids, thomisids, and salticids were predominant in the spider community, evidencing the importance of house gardens in spider diversity. The results are an essential input for the regional data collection of spiders. Planning and managing the city's green spaces from a diversity perspective would be possible with knowledge of biodiversity and its dynamics.

Keywords: House gardens, Diversity, Araneae, Conservation.

Introduction

Amravati is a swiftly evolving city in the eastern part of Maharashtra, India. It is the second largest and most populated city after Nagpur, in the eastern region of

Maharashtra. Urbanisation has been a fundamental factor in the loss of animal populations and poses a severe challenge to biodiversity (Czech *et al.*, 2000; McIntyre, 2000; McKinney, 2002). Habitat fragmentation, local climate and hydrology changes, and population growth contribute to urban development (McIntyre *et al.*, 2001). There is scope for recovery from habitat loss by farming or logging via ecological succession; however, the loss by urbanisation is more permanent, and cities continue to grow and encroach on adjoining ecosystems (McKinney, 2002). With this, the additional habitat is likely to be lost. However, urban cities hold green spaces and cover relatively large sections of urban habitat (Nowak *et al.*, 1996; Savard *et al.*, 2000).

Although urbanisation typically negatively influences biodiversity, some aspects of urban environments may help biodiversity conservation (McKinney, 2002). For instance, throughout gradients of urban expansion, plant diversity, richness, and density may directly correlate with arthropod species richness (Raupp *et al.*, 2010). Recently, household gardens have been acknowledged as essential in conserving biodiversity. Due to land use and garden implementation, urban green covers, such as household and community gardens, have wide spatial habitat variety at small spatial scales. A mixed cropping system which includes vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants that can be used as a secondary source of food and revenue could be considered to characterise home gardens (Dey *et al.*, 2013). People maintain the home gardens as they have aesthetic value, provide food, and sometimes benefit families financially. Due to irrigation, use of fertilisers, and other causes, home gardens can have higher primary productivity than other landscapes. As a result, arthropod numbers, species richness, and biodiversity rise in such microhabitats (McIntyre, 2000; McKinney, 2008).

Arthropod predators also contribute to the ecological services of agricultural and house garden landscapes, such as nutrient cycling and pest control (McIntyre *et al.*, 2001; Isaacs *et al.*, 2009). Green spaces within urban ecosystems can use these services and offer resources and habitats for arthropods in highly urbanised cities (Thompson *et al.*, 2003; Gajbe, 2016a, 2016b, 2021; Meshram, 2011; Misal *et al.*, 2019; Maheshwari *et al.*, 2018; Wasankar & Kakde, 2016; Shirbhate & Shirbhate, 2017). Previous research on spider diversity in the Amravati region shows that local factors influence local diversity and abundance, and landscape factors can also significantly impact organisms (Deshmukh & Raut, 2014; Deshmukh, 2017, 2018; Vairale & Wagh, 2021). Both local and landscape elements may also considerably affect biological control in agricultural areas and house gardens (Schmidt *et al.*, 2004), specifically for spiders. Therefore, testing the influences of both local and landscape factors at multiple progressions is essential.

We surveyed spiders in home gardens at four study sites in Amravati in two forms of localities, old establishments and newly established residential areas, with changes in landscape characteristics and plant species variation. The home gardens in old establishments covered an immense expanse and considerably maintained mixed culture. Since polyculture household gardens of such size are very rare in the core city of Amravati nowadays, the study sites in these localities are preferred for the present survey of spider fauna in the town. Amravati's urban development extends to the new areas, and the residential areas in these localities are mostly flat systems which maintain a planned garden. Such gardens primarily contain ornamental plants like rose, Jasmine, *Hibiscus*, periwinkle, pentas, crotons, and palm with a few large trees like Neem, Gulmohar, Ashok, etc.

The survey was conducted twice a month during the study period from July 2021 to December 2021, making a total of 12 surveys using the three complementary collecting methods: Aerial and ground, hand collecting methods, pitfall traps, and

vegetation beating. This investigation aims to furnish data about the composition and structure of spiders in the house gardens of Amravati. The study also revealed the role of house gardens in diversity conservation in urban habitats. Planning and managing the city's green spaces from a diversity perspective would be possible with knowledge of biodiversity and its dynamics.

Material and Methods

Study area

Amravati is in the eastern part of the state of Maharashtra, India, at 20°56'14.7264"N, 77°46'46.3764"E, and altitude of 343 metres (1125 feet) above MSL. Amravati is a rapidly developing city, the second largest and most populated city after Nagpur in the eastern region of Maharashtra (Fig. 1). Amravati has a tropical wet and dry climate with hot summers and mild to cool winters.

Survey localities

Residential areas of two forms

A) Old establishment - Arjun Nagar and Ganesh Colony,

B) New establishment - Sainagar and Rahatgaon Road

Residential area A had mixed culture, planted without much planning. The plantation at locality B was a planned landscape having predominantly ornamental plants, including a few large trees (Figs. 2-5). Two home gardens in each locality A and B were selected for the survey.



Fig.1. Location of Amravati in India (Location of selected four sampling sites).

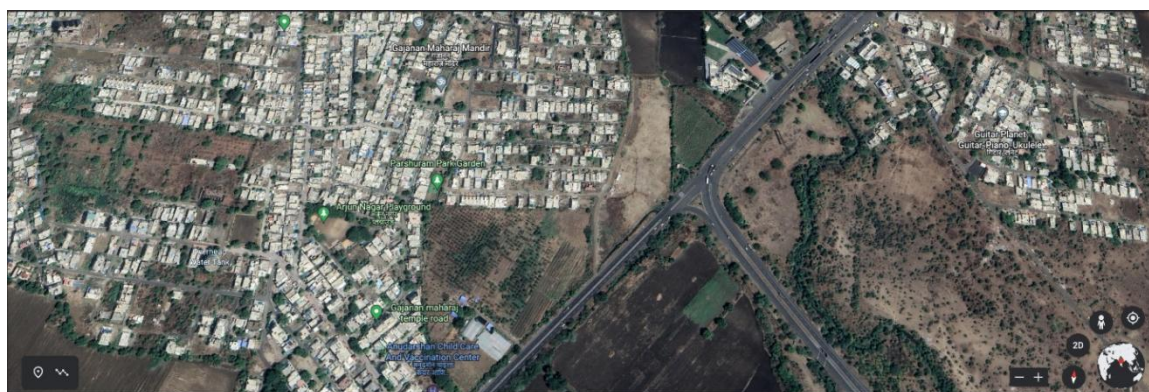


Fig. 2. Sampling Site A: Arjun nagar (Old Establishment).

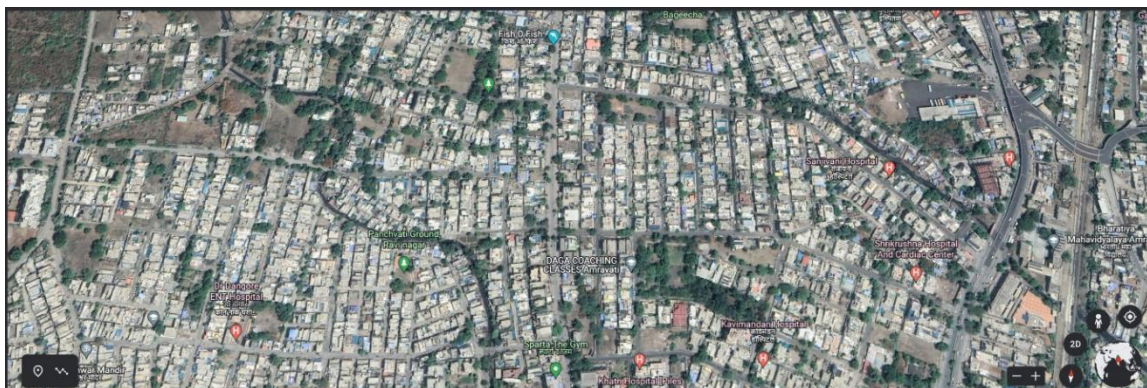


Fig. 3. Sampling Site A: Ganesh Colony (Old Establishment).



Fig. 4. Sampling Site B: Sainagar (New Establishment).



Fig. 5. Sampling Site B: Rahatgaon Road (New Establishment).

Sampling duration and area under investigation

Sampling was conducted from July 2021 to December 2021 in house gardens with a space in the range of 1200 sq.ft. to 4000 sq.ft. in Amravati (Figs. 2-5). Sampling was done twice a month, totalling 12 surveys.

Collecting methods

Pitfall trap, aerial and ground hand collecting methods, and vegetation beating, were mainly used to collect spider specimens. We inspected spiders visually on garden vegetation, under plummeted tree branches, leaf litter etc. For photography, we used a Nikon D 3200, Nikkor 42x Wide Optical Zoom EDVR.

Spider identification and data analysis

The collected species were classified in decreasing order of abundance. The samples were then sorted into labelled bottles containing 70% ethanol to identify and to count them in the laboratory. A photographic database was developed for species identification using a Magnus Zoom Stereo Binocular Microscope model MSZ-BI with Magcam Digital Camera (Mag Cam Dc-5). The handbook "Spider families of the World" by Jocqué & Dippenaar-Schoeman (2007), was referred to identify the family of the spider. We compared the published Indian literature (Books and Monographs) and research papers from India and abroad to further identify the genera and species. For supplementary identification, there are reliable online sites, such as World Spider Catalog (2024).

Species richness and diversity

Species richness and diversity were estimated using the Shannon-Wiener function (Ravi *et al.*, 2015). Spider species were listed, and the complete count of the number of species present in each habitat was done for species composition and species structure indices. The results indicated the spider species diversity in household gardens of selected study sites' old and new residential establishments.

Species Shannon-Wiener index [$H = -\sum P_i \log P_i$], Evenness index [$E = H/H_{\max}$] and Species richness [$S = S - 1/\log N$] was worked out as: Shannon-Wiener index: $H = -\sum P_i \log P_i$ where: H = Shannon-Wiener index, $P_i = n_i / N$, Σ = Sum, n_i = Number of individuals of each species in the sample, N = Total number of individuals of all species in the sample; Evenness: $E = H/H_{\max}$ where: E = Evenness index, ' H ' is the Shannon-Wiener index, $H_{\max} = \log S$, ' S ' is the number of species.

Results and Discussion

In the present investigation, spider diversity in four sampling sites with various ornamental plants like rose, periwinkle, crotons, mogra, *Jasmine*, *Hibiscus*, chrysanthemum, and vegetable plants like brinjal, ridged gourd, okra, and spinach were studied. The spider species composition observed is shown in Table (1). The Shannon-Wiener Diversity Index (H) and Evenness (E) of spider species in different house gardens are represented in Table (2). The species richness of spiders in two types of localities is also calculated.

A total of 2765 specimens were collected, distributed in 16 families and 44 genera from the study area from July 2021 to December 2021 (Table 1). The four most common families, Araneidae, Lycosidae, Thomisidae, and Salticidae make up to 72.65% of all spiders collected from these three habitats. The species abundance observed was highest for the family Araneidae (33.27%), followed by, Lycosidae (18.01%), Thomisidae (11.10%), and Salticidae (10.27%) (Fig. 6). The results of spiders collected by three different collecting methods suggest that spider fauna in the urban house gardens is diverse. Spider abundance was high during July, August, and November, while placated in September and December.

Table 1. The overall taxonomic composition of spiders in the study area, with a total number of species collected from each habitat type.

| No. | Family | Genus | No. of specimens |
|-----|-------------------------------|--|------------------|
| 1. | Araneidae Clerck, 1757 | <i>Argiope aemula</i> (Walckenaer, 1841) | 81 |
| | | <i>Cyclosa</i> sp. | 184 |
| | | <i>Cyrtophora citricola</i> (Forskål, 1775) | 31 |
| | | <i>Eriovixia excelsa</i> (Simon, 1889) | 105 |
| | | <i>Guizygiella indica</i> (Tikader & Bal, 1980) | 41 |
| | | <i>Larinia</i> sp. | 49 |
| | | <i>Neoscona muckerjei</i> Tikader, 1980 | 74 |
| | | <i>Neoscona theisi</i> (Walckenaer, 1841) | 95 |
| | | <i>Neoscona</i> sp. | 247 |
| | | <i>Poltys</i> sp. | 13 |
| | | Subtotal | 920 |
| 2. | Cheiracanthiidae Wagner, 1887 | <i>Cheiracanthium inornatum</i> O. Pickard-Cambridge, 1874 | 23 |
| | | Subtotal | 23 |
| 3. | Clubionidae Simon, 1878 | <i>Clubiona</i> sp. | 22 |
| | | Subtotal | 22 |
| 4. | Eresidae C.L. Koch, 1845 | <i>Stegodyphus sarasinorum</i> Karsch, 1892 | 178 |
| | | Subtotal | 178 |
| 5. | Gnaphosidae Banks, 1892 | <i>Drassodes</i> sp. | 14 |
| | | <i>Zelotes</i> sp. | 23 |
| | | Subtotal | 37 |
| 6 | Hersiliidae Thorell, 1869 | <i>Hersilia savignyi</i> Lucas, 1836 | 122 |
| | | Subtotal | 122 |
| 7. | Lycosidae Sundevall, 1833 | <i>Hippasa</i> sp. | 48 |
| | | <i>Lycosa poonaensis</i> Tikader & Malhotra, 1980 | 170 |
| | | <i>Pardosa pseudoannulata</i> (Bösenberg & Strand, 1906) | 81 |
| | | <i>Pardosa</i> sp. | 102 |
| | | <i>Wadicosa fidelis</i> (O. Pickard-Cambridge, 1872) | 97 |
| | | Subtotal | 498 |
| 8. | Oecobiidae Blackwall, 1862 | <i>Oecobius</i> sp. | 29 |
| | | Subtotal | 29 |

| | | | |
|-----|----------------------------|--|-------------|
| 9. | Oxyopidae Thorell, 1869 | <i>Oxyopes hindostanicus</i> Pocock, 1901 | 38 |
| | | <i>Oxyopes kohaensis</i> Bodkhe & Vankhede, 2012) | 46 |
| | | <i>Peucetia viridana</i> (Stoliczka, 1869) | 41 |
| | | Subtotal | 125 |
| 10. | Pholcidae C.L. Koch, 1850 | <i>Crossopriza lyoni</i> (Blackwall, 1867) | 29 |
| | | <i>Pholcus</i> sp. | 20 |
| | | Subtotal | 49 |
| 11. | Pisauridae Simon, 1890 | <i>Nilus phipsoni</i> (F.O. Pickard-Cambridge, 1898) | 36 |
| | | Subtotal | 36 |
| 12. | Salticidae Blackwall, 1841 | <i>Chrysilla</i> sp. | 28 |
| | | <i>Hasarius adansoni</i> (Audouin, 1825) | 41 |
| | | <i>Hyllus semicupreus</i> (Simon, 1885) | 29 |
| | | <i>Myrmarachne</i> sp. | 15 |
| | | <i>Phintella vittata</i> (C.L. Koch, 1846) | 23 |
| | | <i>Plexippus paykulli</i> (Audouin, 1825) | 49 |
| | | <i>Plexippus petersi</i> (Karsch, 1878) | 61 |
| | | <i>Telamonia dimidiata</i> (Simon, 1899) | 20 |
| | | <i>Thyene</i> sp. | 18 |
| | | Subtotal | 284 |
| 13. | Sparassidae Bertkau, 1872 | <i>Heteropoda</i> sp. | 23 |
| | | <i>Olios</i> sp. | 26 |
| | | Subtotal | 49 |
| 14. | Tetragnathidae Menge, 1866 | <i>Leucauge decorata</i> (Blackwall, 1864) | 26 |
| | | <i>Tetragnatha mandibulata</i> Walckenaer, 1841 | 11 |
| | | Subtotal | 37 |
| 15. | Thomisidae Sundevall, 1833 | <i>Diaea</i> sp. | 23 |
| | | <i>Indoxysticus</i> sp. | 39 |
| | | <i>Massuria</i> sp. | 21 |
| | | <i>Oxytate</i> sp. | 79 |
| | | <i>Thomisus</i> sp. | 92 |
| | | <i>Tmarus</i> sp. | 20 |
| | | <i>Xysticus</i> sp. | 33 |
| | | Subtotal | 307 |
| 16. | Uloboridae Thorell, 1869 | <i>Uloborus</i> sp. | 49 |
| | | Subtotal | 49 |
| | | Total | 2765 |

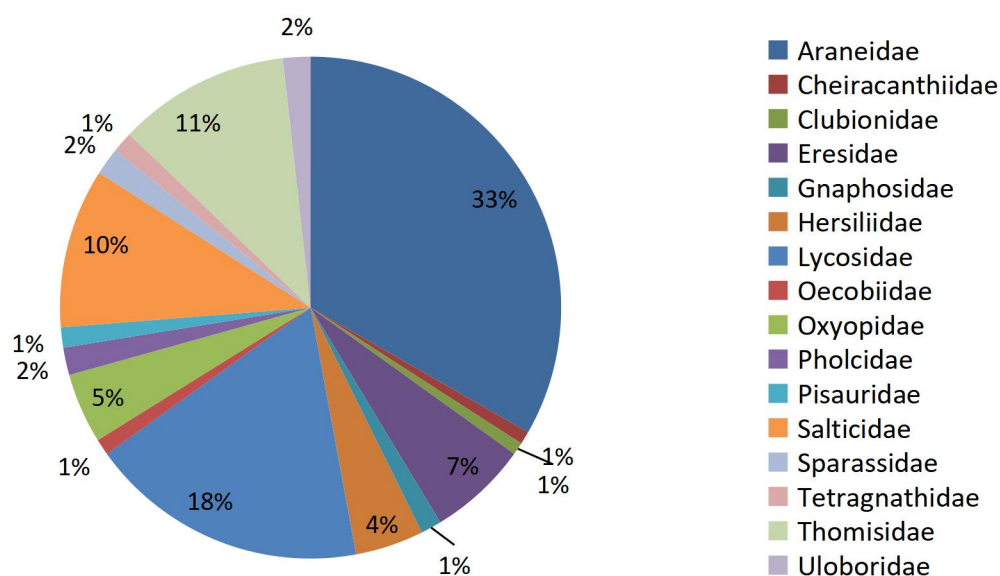


Fig. 6. Percentage composition of spider population recorded during the study.

The data collected of spider species show that one prevalent family, Araneidae, appears in the same abundance in all the selected study sites, but note that many araneids are litter inhabitants. Lycosids are robust and dexterous hunters with excellent eyesight; and as opportunistic hunters, seemed to be thriving in disturbed habitats too. Salticids are agile, visually appealing, day-active predators usually found among foliage in sunny locations and showed abundance in all habitats whilst appearing to have adjusted to the human disturbance. Though thomisids are diurnal ambush hunters, they are common on the ground as well; some famous for waiting in flowers.

Home gardens play an important role in conserving agro-biodiversity; they serve as refuges for spider varieties that were once more widespread in the undisturbed ecosystem or that developed over generations in the gardens themselves. Taxonomic richness and abundance were higher in old established gardens with some vegetable and fruit plants and comparatively low in new establishment home gardens where ornamental flowers were predominant. Certain groups like araneids, lycosids, and salticids showed variation in abundance between habitats.

Diversity indices computed for the spider species from different localities show a difference in values of Species Richness (S), Shannon-Wiener Diversity Index (H) and Evenness (E) in four sampling sites. Spiders of the Shannon-Wiener diversity index (H) are presented in Table (2). It showed that there is less variation of spider species diversity index in the family Gnaphosidae, Pholcidae, Sparassidae, and Tetragnathidae $H = 0.663-0.981$ in home gardens. The other families observed recorded higher diversity indices $H = 1.1-2.09$. The values higher than 1.00 indicate that the habitat is supporting survival of the spider species (Kumar & Mishra, 2008).

The values of Evenness showed that there is a range from $E = 0.886-0.997$, In both establishments, as shown in Table (2), indicating the abundances similarity of different species in the study area was close.

Table 2. Shannon-Wiener diversity index calculated.

| S.No. | Family | Total no. | Shannon diversity index H | Evenness E | Richness (number of species) S | Average population size AP |
|-------|------------------|-------------|---------------------------|------------|--------------------------------|----------------------------|
| 1 | Araneidae | 920 | 2.04 | 0.887 | 10 | 92 |
| 2 | Cheiracanthiidae | 23 | 0 | -- | 1 | 23 |
| 3 | Clubionidae | 22 | 0 | -- | 1 | 22 |
| 4 | Eresidae | 178 | 0 | -- | 1 | 178 |
| 5 | Gnaphosidae | 37 | 0.663 | 0.957 | 2 | 18.5 |
| 6 | Hersiliidae | 122 | 0 | -- | 1 | 122 |
| 7 | Lycosidae | 498 | 1.53 | 0.951 | 5 | 99.6 |
| 8 | Oecobiidae | 29 | 0 | -- | 1 | 29 |
| 9 | Oxyopidae | 125 | 1.1 | 0.997 | 3 | 41.7 |
| 10 | Pisauridae | 36 | 0 | -- | 1 | 36 |
| 11 | Pholcidae | 49 | 0.676 | 0.976 | 2 | 24.5 |
| 12 | Salticidae | 284 | 2.09 | 0.953 | 9 | 31.6 |
| 13 | Sparassidae | 49 | 0.691 | 0.997 | 2 | 49 |
| 14 | Tetragnathidae | 37 | 0.609 | 0.878 | 2 | 18.5 |
| 15 | Thomisidae | 307 | 1.77 | 0.908 | 7 | 43.9 |
| 16 | Uloboridae | 49 | 0 | -- | 1 | 49 |
| | Total | 2765 | | | | |

Several authors have already indicated the importance of home gardens for arthropod diversity (Dey *et al.*, 2013; Shochat *et al.*, 2008), and the arachnids are the second largest contributor (8.3%) of total arthropod diversity after insects. According to earlier reports, the spider fauna of the Amravati forest region is represented by 14 families and 37 genera (Keswani & Vankhede, 2014; Vairale & Wagh, 2021). The present study represents 16 families, 44 genera (Table 1), collected from the household gardens during the survey period.

Conclusion

During the investigation, we studied 2765 specimens belonging to 44 genera of 16 spider families. The present work includes the taxonomic position and a list of diversified species of spiders. The major families abundant in these home gardens are Araneidae, Lycosidae, Thomisidae, Salticidae, and Oxyopidae. The study highlights data related to the species distribution and abundance in home gardens in response to the urbanisation and availability of food. In some cases, spiders sometimes tend to move across different habitats in search of food and suitable spaces to build webs. This condition affects the relationship between spider abundance and habitat structure. The diversity index calculated for the present data indicates that the habitat is supporting the survival of the spider species.

Spiders are very much important arthropods and beneficial bio-control agents in urban habitat. Due to their ability for predation, spiders are an essential component of all ecosystems and contribute to a healthy ecosystem. This study provides an updated checklist and baseline data of spider diversity from household gardens in old and new

establishments of Amravati (Maharashtra State, India). The composition and structure of spiders recorded in the present investigation show a great diversity of spiders in the home gardens of Amravati and suggests more such study for comprehensive spider data of the region.

The role of spiders as biological control is confirmed by many researchers. Spiders can also exert significant top-down effects, meaning that plant damage by insect herbivores is lower, when spiders are present than when they are absent. Encouraging hunting spiders by the addition of mulch, which provides shelter and humidity, resulted in a significant decrease in plant damage in vegetable gardens (Riechert & Bishop, 1990). The common pest observed in the selected home gardens were aphid, red imported fire ant, grasshopper, leaf hopper, and caterpillars. The members of Salticidae, Thomisidae, and Linyphiidae families are known for their predator habit (Maloney *et al.*, 2003) which control pests on vegetable, fruit and ornamental plants. In the home garden, it has been observed that some of the orb web builder araneids construct their webs in the evening and disrupt it in the morning and many insects get trapped in them, cutting the use of pesticides by the gardeners.

It is hard to draw conclusions based on a limited area of study; still, the present scenario infers spider diversity decreases with fragmentation, although abundance is increased. But this should not stipulate that fragmentation has a negative effect, but rather open up new dimensions for study, safeguard, preservation and protection of spider diversity. Furthermore, several studies in India and elsewhere have shown that home gardens are sustainable and important in situ conservation system. (Keswani *et al.*, 2012; Dey *et al.*, 2013).

The present study confirms the role of home gardens in diversity, conservation and spiders as predators. The results obtained are an important input for the regional data collection of spiders. Planning and management of the city's green spaces from the perspective of diversity would be possible with knowledge of biodiversity and its dynamics.

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Differences in the morphometric and life-history parameters of sympatric galeodids (Solifugae) of the Lesser Caucasus

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Abstract

Data on size characters are obtained as a result of studying samples of four sympatric species of solpugids *Galeodes araneoides*, *Galeodes armeniacus*, *Galeodes caspius*, and *Galeodes nachitschevanicus*. Data on bioecology parameters are taken from literature. Interspecific and intersexual differences in size characters were revealed. A wide range of correlations between size traits and the main life-history parameters of species is shown. The variability of size characters in different species and sexual groups is presumably due to the specific use of environmental conditions and the differentiated role of each sex in reproductive activity.

Keywords: size characters, indices, sexual dimorphism, life-history parameters, solpugids.

Introduction

The genus *Galeodes* Oliver, 1791 is represented in the Lesser Caucasus by 8 species, of which the most numerous are 4 species: *Galeodes araneoides* (Pallas, 1772), *Galeodes armeniacus* Birula, 1929, *Galeodes caspius* Birula, 1890, and *Galeodes nachitschevanicus* Aliev, 1985. The ranges of these species in the world vary greatly in size. The range of *G. araneoides* covers a vast territory from Northeast Africa to Central Asia. *G. caspius* is found in Palestine/Israel, Azerbaijan, Iran, Kazakhstan, Central Asian countries and China. The range of *G. armeniacus* is limited to the Lesser Caucasus region (Armenia, southern part of Azerbaijan, northern part of Iran). *G. nachitschevanicus* is the most narrowly distributed among the species under

consideration, the distribution of which is limited to the southeastern part of the Lesser Caucasus (within the Nakhchivan Autonomous Republic) (Aliev, 1984, 1985; World Solifugae Catalog, 2022). In the southeastern part of the Lesser Caucasus region, the ranges of all these species overlap, which creates the opportunity for an objective consideration of the morphological, and bioecological differences between them.

Some data on size characters and size sexual dimorphism of these species is given in the literature. For example, the characteristics of the length of the body, legs and chelicerae of solpugids are widely known as sexually dimorphic, since this is repeatedly reported by the authors in the description of each species (Birula, 1938; Aliev, 1984; Gadzhiev, 1996; Bird *et al.*, 2015). However, interspecific and intersexual differences in size characters were not analyzed in connection with the life history parameters of these animals, and there is insufficient data on the adaptive and functional significance of these structures.

The purpose of the study was to identify interspecific and intersexual differences in the size characteristics of sympatric solpugids, comparison with their life history parameters, and identification of diagnostic, adaptive and functionally significant characters and indices.

Material and Methods

For morphometric comparison of species, we used material collected in different years in the southeastern part of the Lesser Caucasus (Julfa and Ordubad regions of the Nakhchivan Autonomous Republic). The external morphology of solpugids was studied according to 20 morphometric characters, for the designation of which the following abbreviations were adopted: Tot.L = total body length, Pr.L = propeltidium length, Pr.W = propeltidium width, MM.L = length of thoracic segments (meso-metapeltidium), MM.W = width of the thoracic segments, Ops.L = opisthosoma length, Ops.W = opisthosoma width, Leg.(1-4)L = leg length (1-4), Fem.4L = length of the femur of the 4th leg, Tib.4L = length of the tibia of the 4th leg, Mtr.4 L = length of the metatarsus of the 4th leg, Pl.L = pedipalp length, Fem.pl.L = length of the femur of the pedipalp, Tib.pl.L = length of the pedipalp tibia, Mtr.pl.L = length of the metatarsus of the pedipalp, Ch.ff.L = length of the upper cheliceral finger (fixed finger), Ch.mf.L = length of the lower cheliceral finger (movable finger).

A total of 175 specimens of solpugids were studied: 78 males and 97 females. The species and sex of individuals were determined based on key characters indicated in the literature (Birula, 1938; Turk, 1960; Aliev, 1984, 1985; Bird *et al.*, 2015; Harms & Dupérré, 2018). Measurements of characters were carried out with a digital caliper and an eyepiece micrometer of an MBS-1 microscope, with an accuracy of 0.01 mm. Additionally, 9 indices of proportion between pairs of characters were calculated: Pr.L/Pr.W, MM.L/MM.W, Ch.ff.L/Ch.mf.L, Leg.1.L/Tot.L, Leg.2.L/Tot.L, Leg.3.L/Tot.L, Leg.4.L/Tot.L, Pl. L/Tot.L, Pr.L/Tot.L allowing to evaluate the range of variability, complement the overall picture of the significance and relationship of characters. Numerical assessment of the severity of sexual dimorphism was carried out by calculating for each size trait (average values were used) the index of dimorphism (ID) (Levenson, 1990) according to the formula: $D = [(P_2 - P_1)/P_1] \times 10$, where P2 is the sample average for one sex, P1 = sample mean for the sign of the other sex. Unlike other indicators of sex comparison, the dimorphism index is little dependent on the sample size. The significance of differences in mean values of characteristics was determined using Student's t-test for paired comparisons. In statistical analysis, differences in mean values were considered significant with *t* criterion > 2, significance level $p \leq 0.001-0.05$.

Pearson's correlation coefficient was used to establish relationships between numerical data. Statistical data processing and diagramming were carried out using Microsoft Excel 2010 and PAST 4.03 (Hammer *et al.*, 2001). In discussing the results, the article uses its own and literature data on the biology and ecology of the species being compared.

Results

The average values of 20 morphometric characters and the dimorphism index (ID) calculated on their basis for each pair of characters (male/female) for four species of solpugids are presented in the following table (Table 1).

Table 1. Average values of size traits and dimorphism index (ID) of male and female solpugids.

| No. | Trait | I | | II | | III | | IV | |
|-----|------------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|
| | | ♂/♀ | ID | ♂/♀ | ID | ♂/♀ | ID | ♂/♀ | ID |
| 1 | Tot. L | 43.11/47.61 | 1.04 | 40.87/41.83 | 0.23 | 40.30/48.55 | 2.04 | 34.90/42.20 | 2.09 |
| 2 | Pr. L | 16.23/17.80 | 0.96 | 15.60/15.67 | 0.04 | 7.24/7.50 | 0.35 | 12.71/14.86 | 1.69 |
| 3 | Pr. W | 8.51/10.47 | 2.30 | 8.27/8.89 | 0.74 | 9.87/11.20 | 1.34 | 6.28/7.07 | 1.25 |
| 4 | MM. L | 3.26/3.71 | 1.38 | 2.63/4.57 | 7.37 | 2.98/3.77 | 2.65 | 2.10/3.05 | 4.52 |
| 5 | MM.W | 5.29/4.86 | -0.80 | 4.15/4.82 | 1.61 | 5.16/4.19 | -1.87 | 4.27/4.03 | -0.56 |
| 6 | Ops. L | 19.63/22.33 | 1.37 | 16.58/19.02 | 1.47 | 18.8/19.20 | 0.21 | 17.81/20.45 | 1.48 |
| 7 | Ops. W | 8.23/12.85 | 5.61 | 9.46/11.03 | 1.65 | 8.56/11.04 | 2.89 | 7.51/11.45 | 5.24 |
| 8 | Leg. 1L | 38.10/30.10 | -2.09 | 30.09/34.34 | 1.41 | 44.62/32.56 | -2.70 | 32.61/24.08 | -2.61 |
| 9 | Leg. 2L | 31.33/26.06 | -1.68 | 30.55/26.40 | -1.35 | 32.70/28.06 | -1.41 | 28.50/22.66 | -2.04 |
| 10 | Leg. 3L | 38.53/31.82 | -1.74 | 37.10/34.86 | -0.60 | 43.20/36.50 | -1.55 | 33.72/27.45 | -1.85 |
| 11 | Leg. 4L | 54.46/51.25 | -0.58 | 60.79/51.31 | -1.55 | 56.60/51.23 | -0.94 | 52.21/41.68 | -2.01 |
| 12 | Fem. 4L | 8.82/10.56 | 1.97 | 13.26/12.09 | -0.88 | 8.65/9.25 | 0.69 | 7.99/10.05 | 2.57 |
| 13 | Tib. 4L | 9.30/10.19 | 0.95 | 13.10/10.63 | -1.88 | 9.31/10.37 | 1.13 | 8.63/10.0 | 1.58 |
| 14 | Mtr. 4L | 5.86/6.74 | 1.50 | 10.27/9.53 | -0.72 | 6.75/7.02 | 0.40 | 6.42/6.49 | 0.10 |
| 15 | Pl. L | 47.64/38.80 | -1.85 | 47.21/44.05 | -0.66 | 56.53/40.20 | -2.88 | 46.72/34.80 | -2.55 |
| 16 | Fem. pl. L | 11.19/13.11 | 1.71 | 18.31/16.04 | -1.23 | 11.08/12.02 | 0.84 | 9.72/9.75 | 0.03 |
| 17 | Tib. pl. L | 9.13/11.43 | 2.51 | 15.93/14.96 | -0.60 | 9.51/10.61 | 1.15 | 9.25/10.63 | 1.49 |
| 18 | Mtr. pl. L | 6.55/8.92 | 3.61 | 11.48/10.75 | -0.63 | 7.69/8.43 | 0.96 | 7.22/8.66 | 1.99 |
| 19 | Ch. ff. L | 10.57/13.36 | 2.63 | 10.24/10.63 | 0.38 | 11.23/13.44 | 1.96 | 8.46/10.07 | 1.90 |
| 20 | Ch. mf. L | 10.10/13.99 | 3.85 | 10.38/10.65 | 0.26 | 8.85/9.80 | 1.07 | 9.19/10.89 | 1.84 |

Notes: I = *G. araneoides*, II = *G. armeniacus*, III = *G. nachitschevanicus*, IV = *G. caspius*, ID = dimorphism index.

Interspecies differences in size characters. Males of *G. araneoides*, compared with males of other species, were prevailing in terms of total body length (Tot.L), length of propeltidium (Pr.L) and opisthosoma (Ops.L), length and width of thoracic segments (MM.L, MM.W). For characters of propeltidium width (Pr.W), length of 1-3 legs (Leg.1.L, Leg.2.L, Leg.3.L), length of pedipalp (Pl.L) and upper finger of chelicera (Ch.ff.L), superiority is noted for males of *G. nachitschevanicus*. Males of *G. armeniacus* were leading for characters of total length of the 4th leg (Leg.4.L), femur length (Fem.4.L), tibia length (Tib.4.L), and metatarsus length (Mtr.4.L) of the 4th leg. For the other five characters (Ops.W, Fem.pl.L, Tib.pl.L, Mtr.pl.L, Ch.mf.L) no clear size hierarchies between species were found. Females of *G. araneoides* in comparison with females of other species are marked by superiority on characters of length and width of propeltidium (Pr.L, Pr.W), width of thoracic segments (MM.W), length and width of opisthosoma (Ops.L, Ops.W). Females of *G. nachitschevanicus* were leading in total body length (Tot.L), length of the 2nd and 3rd legs (Leg.2.L, Leg.3.L), length of the

fixed finger of the chelicera (Ch.ff.L). For characters of length of the 1st and 4th legs (Leg.1.L, Leg.4.L) and pedipalps (Pl.L), females of *G. araneoides* were dominant. Females of *G. caspius* dominated females of other species exclusively by the length of the movable finger of the chelicera (Ch.mf.L). For the other 7 characters (MM.L, Fem.4.L, Tib.4.L, Mtr.4.L, Fem.pl.L, Tib.pl.L, Mtr.pl.L) no clear hierarchies among females of any species were observed. Interspecific differences in the complex of characters separately for each sex group are presented in the diagrams (Fig. 1).

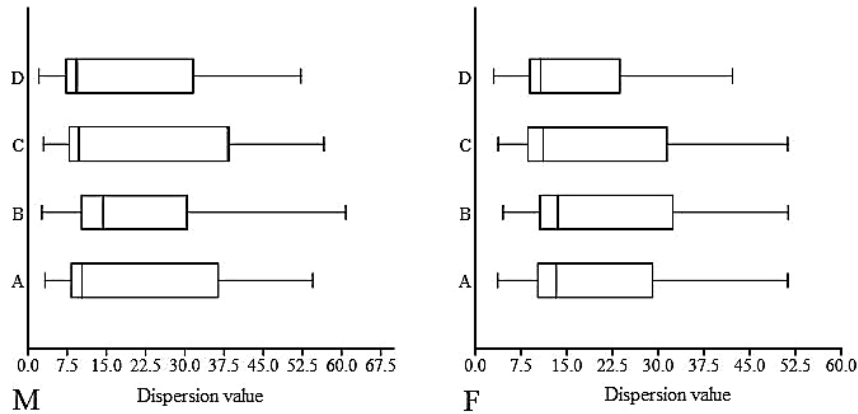


Fig. 1. Interspecific differences in the complex of traits in males (M) and females (F) of solpugids: A = *G. araneoides*, B = *G. armeniacus*, C = *G. nachitschevanicus*, D = *G. caspius*.

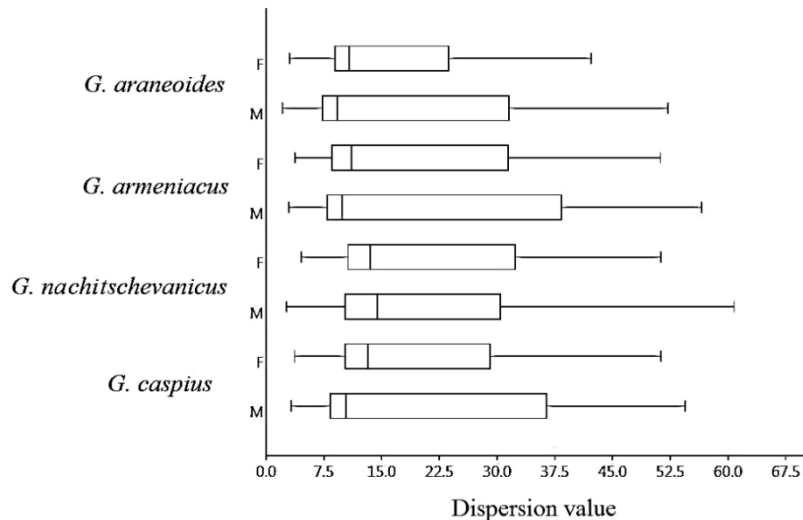


Fig. 2. Generalized diagram of the manifestation of sexual dimorphism in male (M) and female (F) solpugids according to the average values of size traits.

Sex differences in size characters. Comparison of samples by mean values of size characters of males and females revealed sex differences to varying degrees for all 20 characters, of which differences in 4-8 characters (in different species) were statistically significant ($t > 2$; $p < 0.01$), accounting for 20-40% of the total number. Males of *G. araneoides* differed from females by greater values of 6 size characters, for the other 14 characters the size of females exceeded the size of males. Of the total number of distinctive characters noted for both sexes of this species, 8 characters (Tot.L., Ops.W, Leg.1-4.L, Pl.L, Ch.mf.L) were reliable ($t = 2.27-6.25$; $p = 0.001-0.029$). The size of males of *G. armeniacus* exceeded the size of females for 10 characters, for other

characters females exceeded the size of males. However, of all the marked characters, reliability in this species was noted for 4 characters (Leg.1.L, Leg.2.L, Leg.4.L, Pl.L) ($t = 2.23-6.70$; $p = 0.001-0.031$). Males of *G. nachitschevanicus* and *G. caspius* exceeded the size of females in 6 characters, females exceeded the size of males in 14 characters. Of these, 6 traits (Tot.L, Leg.1-4.L, Pl.L) were statistically significant for *G. nachitschevanicus* ($t = 3.28-8.53$; $p = 0.001-0.002$) and 7 traits (Tot.L, Ops.W, Leg.1-4.L, Pl.L) for *G. caspius* ($t = 2.79-7.45$; $p = 0.001-0.008$). The generalized range diagram shows the range of dispersion of the studied set of average values of all dimensional traits and their ratio in males and females (Fig. 2).

Sex differences by index of dimorphism (ID). According to the summarised values of the index of dimorphism (ID), sexual dimorphism was more pronounced in the samples of *G. araneoides* (22.65) and *G. caspius* (16.15), and to a lesser extent in the samples of *G. nachitschevanicus* (6.33) and *G. armeniacus* (5.06). When considering the ID of each of the characters separately, the picture of the manifestation of sexual dimorphism in the samples looked as follows: Sexual dimorphism in total body length (Tot.L) was manifested to a greater extent in the samples of *G. caspius* (2.09) and *G. nachitschevanicus* (2.04), to a lesser extent in the sample of *G. armeniacus* (0.23) and *G. araneoides* (1.04). In terms of leg length (Leg.1-4L), dimorphism was manifested in all 4 samples (with the exception of Leg.3L in *G. armeniacus*), but was most pronounced in the sample of *G. caspius* (-8.51), these characters had the lowest values in the sample *G. araneoides* (-6.09) and *G. armeniacus* (-2.09). In terms of pedipalp length (Pl.L), the sample *G. nachitschevanicus* was the leader (-2.88), and the outsider was the sample *G. armeniacus* (-0.66).

Sex differences in trait ratio indices. Sexual differences of individuals in samples with varying degrees of severity were manifested in 6-7 indices of character ratios in different species (Table 2).

Table 2. Indices of the ratio of the main dimensional characters of solpugids.

| No. | Index | I | <i>t</i> | II | <i>t</i> | III | <i>t</i> | IV | <i>t</i> |
|-----|-----------------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| | | ♂/♀ | | ♂/♀ | | ♂/♀ | | ♂/♀ | |
| 1 | Pr.L/Pr.W | 1.90/1.70 | 2.83 | 2.13/1.96 | 1.72 | 0.73/0.66 | 0.99 | 2.02/2.10 | 0.81 |
| 2 | MM.L/MM.W | 0.61/0.76 | 2.12 | 0.63/0.55 | 0.81 | 0.57/0.89 | 3.23 | 0.49/0.75 | 3.64 |
| 3 | Ch.ff.L/Ch.mf.L | 1.04/0.95 | 1.27 | 0.98/0.96 | 0.20 | 1.14/1.51 | 3.74 | 0.92/0.92 | 0 |
| 4 | Leg.1L/Tot.L | 0.88/0.63 | 3.54 | 0.73/0.82 | 0.91 | 1.10/0.67 | 4.34 | 0.93/0.57 | 3.64 |
| 5 | Leg.2L/Tot.L | 0.72/0.54 | 2.55 | 0.74/0.62 | 1.21 | 0.81/0.57 | 2.42 | 0.81/0.53 | 2.83 |
| 6 | Leg.3L/Tot.L | 0.89/0.66 | 3.25 | 0.90/0.83 | 0.71 | 1.07/0.75 | 3.23 | 0.96/0.65 | 3.13 |
| 7 | Leg.4L/Tot.L | 1.26/1.07 | 2.69 | 1.48/1.47 | 0.10 | 1.40/1.05 | 3.54 | 1.49/0.98 | 5.15 |
| 8 | Pl.L/Tot.L | 1.10/0.81 | 4.10 | 1.15/1.13 | 0.20 | 1.40/0.82 | 5.86 | 1.33/0.82 | 5.15 |
| 9 | Pr.L/Tot.L | 0.37/0.37 | 0 | 0.43/0.44 | 0.10 | 0.17/0.15 | 0.20 | 0.36/0.35 | 0.10 |

Notes: I = *G. araneoides*, II = *G. armeniacus*, III = *G. nachitschevanicus*, IV = *G. caspius*.

Sex differences in *G. araneoides* were expressed by large values of the Pr.L/Pr.W indices, MM.L/MM.W, Leg.1-4L/Tot.L, Pl.L/Tot.L ($t = 2.12-4.10$; $p < 0.01$); *G. nachitschevanicus* – according to indices MM.L/MM.W, Ch.ff.L/Ch.mf.L, Leg.1-4L/Tot.L, Pl.L/Tot.L ($t = 2.42-5.86$; $p < 0.01$); sex differences in *G. armeniacus* were not reliably demonstrated in any of the indices; for *G. caspius*, sex differences were significant in the same group of indices as *G. araneoides*, with the exception of the Pr.L/Pr.W index ($t = 2.83-5.15$; $p < 0.01$).

Comparison of samples based on the totality of indices showed a more pronounced breadth of manifestation of their variability in males and to a lesser extent in females of the studied species (with the exception of *G. nachitschevanicus*). The greatest

dispersion in males was observed in the indices of proportions with the total body length (Tot.L) of the Leg.1-4L and Pl.L traits; in females according to the relationship with body length of the characters MM.L and Ops.W.

In the diagram, the range (interquartile range), as well as the upper and lower limits of the dispersion of the indices show the breadth of manifestation of their variability (Fig. 3).

Based on the sum of the average values of all traits and trait ratio indices, the severity of sexual dimorphism of species was built (in increasing order) as follows: *G. armeniacus* → *G. nachitschevanicus* → *G. caspius* → *G. araneoides*. A strong positive correlation was noted between the sums of the average values of all dimensional characteristics ($r = 0.956-0.986$) and 9 indices ($r = 0.696-0.996$). The average values of most dimensional characters, especially such as meso-metapeltidium length (MM.L) and opisthosoma width (Ops.W), are smaller in males than in females (Table 1). The dimorphism index (ID) for pairs of these characters (male-female) was in the range: 1.21-4.24 (MM.L) and 1.42-3.59 (Ops.W). Dimensional indices of limb length (Leg.1-4L) and pedipalps (Pl.L) in males are significantly greater than in females ($t = 2.27-8.53$; $p \leq 0.001-0.029$ and $t = 2.23-11.55$; $p \leq 0.001-0.031$ respectively). The dimorphism index for pairs of these characters was 0.62-2.65 (*G. araneoides*), 0.64-1.84 (*G. armeniacus*), 1.04-4.06 (*G. nachitschevanicus*) and 2.28-3.54 (*G. caspius*).

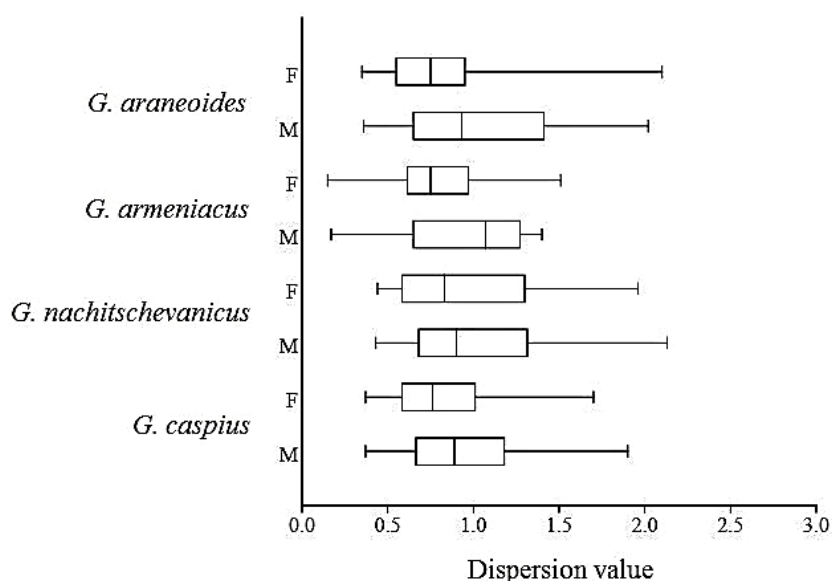


Fig. 3. Generalized diagram of the manifestation of sexual dimorphism in male (M) and female (F) solpugids according to indices of character ratios.

Discussion

Peculiarities of species are characterised not only and not so much by morphological differences of individual or groups of traits, but also by the peculiarities of their relationships with different important life functions of living organisms (Mayr, 1968). Consequently, comparative studies of morphometric differences and dimorphism of species may be interesting not only in taxonomic terms, but also in their relationship with different biological and functional characteristics of the life cycle of the species under study.

The compared species are objectively united by a number of general biological and ecological features: a similar general morphological structure, identical methods and

timing of reproduction, type of ontogenesis (with the exception of *G. caspius*) and the number of stages of postembryonic development, hypertrophic nutrition, high metabolic rate, predominantly nocturnal activity, etc. (Aliev & Gadzhiev, 1983a; Aliev, 1984). Some important distinctive features and characteristics were noted in them (in particular for the populations of the Lesser Caucasus): 1) a five-year development cycle with 4-5 winterings of nymphs, ecological plasticity (according to topical and trophic principles), trimodal night activity, increased digging activity and numerical female predominance in *G. araneoides*; 2) a one-year development cycle with one wintering of nymphs, a pronounced attachment to individual territories and a numerical predominance of males in *G. caspius*; 3) narrow biotopic or microstationary occurrence and unimodal nocturnal activity in *G. nachitschevanicus*; 4) tolerance to individuals of their own species (with a minimum of encounters), approximately equal sex ratio, bimodal rhythm of nocturnal activity and unexpressed burrowing activity (they prefer to inhabit rodent burrows) in *G. armeniacus*. The most significant bioecological characteristics of species, compiled according to their own and literary data (Aliev & Gadzhiev, 1983a, b; Aliev, 1984, 1985; Gadzhiev, 1996; Novruzov, 2017; Aliev & Novruzov, 2018; Novruzov, 2020; Novruzov, 2021, 2024) are given in table (3).

Table 3. Some life-history characteristics of solpugids of the genus *Galeodes* from populations of the Lesser Caucasus according to our own and literary data.

| Parameter | <i>Galeodes araneoides</i> | <i>Galeodes armeniacus</i> | <i>Galeodes nachitschevanicus</i> | <i>Galeodes caspius</i> |
|--|-----------------------------------|-----------------------------------|------------------------------------|-----------------------------------|
| Breeding period | May-August | June-August | June-August | May-July |
| Number of eggs in a clutch (average) | 80-110 (95) | 70-80 (75) | 60-70 (65) | 40-50 (45) |
| Relative abundance, species/ha (density) | ≥ 10 (0.42) | ≤ 9 (0.03) | ≤ 7 (0.09) | ≤ 1 (0.01) |
| Sex ratio | $\sigma < \varphi$ (1:1.3) | $\sigma = \varphi$ (1:1) | $\sigma \geq \varphi$ (1:1; 1.1:1) | $\sigma > \varphi$ (1.2:1) |
| Seasonal activity (days) | April-October (184 \pm 2.21) | May-September (149 \pm 2.98) | June-September (122 \pm 3.10) | May-September (137 \pm 3.64) |
| Duration wintering (days) | 181 \pm 2.58 | 216 \pm 3.41 | 243 \pm 2.75 | 228 \pm 4.32 |
| Nutrition spectrum | 18 orders | 13 orders | 11 orders | 5-7 orders |
| Average weight of food eaten (% of body weight) (σ/φ) | 49.6/54.7 | 36.4/42.2 | 29.5/36.5 | 30.1/36.7 |
| Width of trophic niches | 82.6 | 59.1 | 30.8 | 22.3 |
| Intensity of movements, m (σ/φ) | 54.1/40.0 | 26.5/22.1 | 30.4/29.0 | 19.1/15.4 |
| Average speed of movement, cm/sec (σ/φ) | 128/105 | 88/76 | 102/90 | 65/50 |

In the conditions of the southeastern part of the Lesser Caucasus, for *G. armeniacus* and *G. nachitschevanicus*, we noted an earlier departure for wintering of nymphs after the completion of the 2nd moult (late September – early October) and a later departure for *G. araneoides* (late October). For *G. caspius*, the timing of nymphs leaving for wintering under natural conditions could not be determined. However, when kept in laboratory conditions, refusal of food in *G. caspius* nymphs was observed 2-3 weeks after completion of the 3rd moult, which may indirectly indicate a later departure

for wintering. The total number of winterings in *G. araneoides* is 4-5, starting with nymphs of the 2nd instar, in *G. armeniacus* and *G. nachitschevanicus* there are 4 winterings each, starting with nymphs of the 2nd instar, only in *G. caspius* there is only one wintering of nymphs of 3-4 age.

Solpugids exhibit different selectivity in choosing a biotope or microstations in a biotope, and differ in their feeding spectra and food acquisition strategies. Each species preferred habitats of a certain type, as evidenced by comparative data on their abundance in different biotopes (Novruzov, 2024). For example, *G. araneoides* and *G. caspius* were predominantly observed in biotopes with grey and sandy soil types, since these species are characterized by active digging activity. What distinguished them was that *G. araneoides* digs mainly burrows for short-term use (30-50 burrows per season), while *G. caspius* digs burrows for longer-term use (8-10 burrows per season). In general, these two species demonstrated greater topical plasticity in distribution and abundance compared to other species. The *G. armeniacus* rarely digs its own burrows, mainly using ready-made shelters; therefore, it predominated in biotopes with a large number of burrows of small rodents. *G. nachitschevanicus* prefers to dig burrows that are small in length and depth, mainly under stones and fragments of rocks and therefore sticks to rocky areas of the landscape.

The food spectrum of *G. araneoides* is taxonomically more representative (18 orders) than that of *G. armeniacus* and *G. nachitschevanicus* (13 and 11 orders, respectively). In the pairs *G. araneoides* – *G. armeniacus* and *G. armeniacus* – *G. nachitschevanicus*, an average level of values for the degree of diet overlap was noted; the level is above average – in the pair *G. araneoides* – *G. nachitschevanicus*. Differences in the feeding patterns of solpugids were associated with different degrees of selectivity of predators for certain taxa and size groups of prey, a heterogeneous proportion of arthropods in biotopes, and different productivity of the food acquisition strategies they used. Nighttime individual observations of solpugids showed that they mainly use three strategies for obtaining food: 1) active search and pursuit of prey on the surface (“actively searching”), 2) waiting for prey to appear, lying on the surface (“sit-and-wait”), 3) waiting for prey to appear in ambush inside the shelter (“ambush”). At the same time, *G. araneoides* actively used all three of the above strategies for obtaining food. The strategy of active search with pursuit was mainly used by them at night, and the “sit-and-wait” and “ambush” strategies were used alternately both in the dark and twilight, and in the daytime with heavy clouds (approximately 7-8 points according to 10 point WMO scale). The remaining three species of solpugids hunted exclusively at night, using mainly: *G. caspius* – “sit-and-wait” and “ambush” strategies, *G. armeniacus* – “active search”, “ambush” strategies, *G. nachitschevanicus* – “active search” and “sit-and-wait” strategies. Of the compared species of solpugids, *G. araneoides* showed the greatest, *G. nachitschevanicus* and *G. caspius* – the least ecological plasticity (niche width) in terms of topical and trophic parameters (Novruzov, 2024). In addition, the species under consideration differ somewhat in terms of relative abundance and the number of eggs laid in clutches, growth rates and timing of wintering at the stage of nymphal ontogenesis (Aliev, 1984).

According to the literature, it is known that size traits are positively correlated with many aspects of the biology and ecology of insects (reproduction rates, duration of ontogenesis, abundance, locomotor activity, etc.) (Stearns, 1992). For solpugids, only a close correlation of body size with the number of eggs in a clutch (*Eremobates marathoni*) has been noted in the literature (Punzo, 1998). The correlation analysis carried out between the dimensional characteristics of solpugids and some of their life parameters expressed in digital equivalents showed a wide range of correlations between

these structures. These relationships were most pronounced with the following parameters: clutch size, density (ind./ha), average weight of food eaten, width of the trophic niche, locomotor activity (intensity and speed of movement of animals), sex ratio, duration of periods of activity and hibernation (Fig. 4).

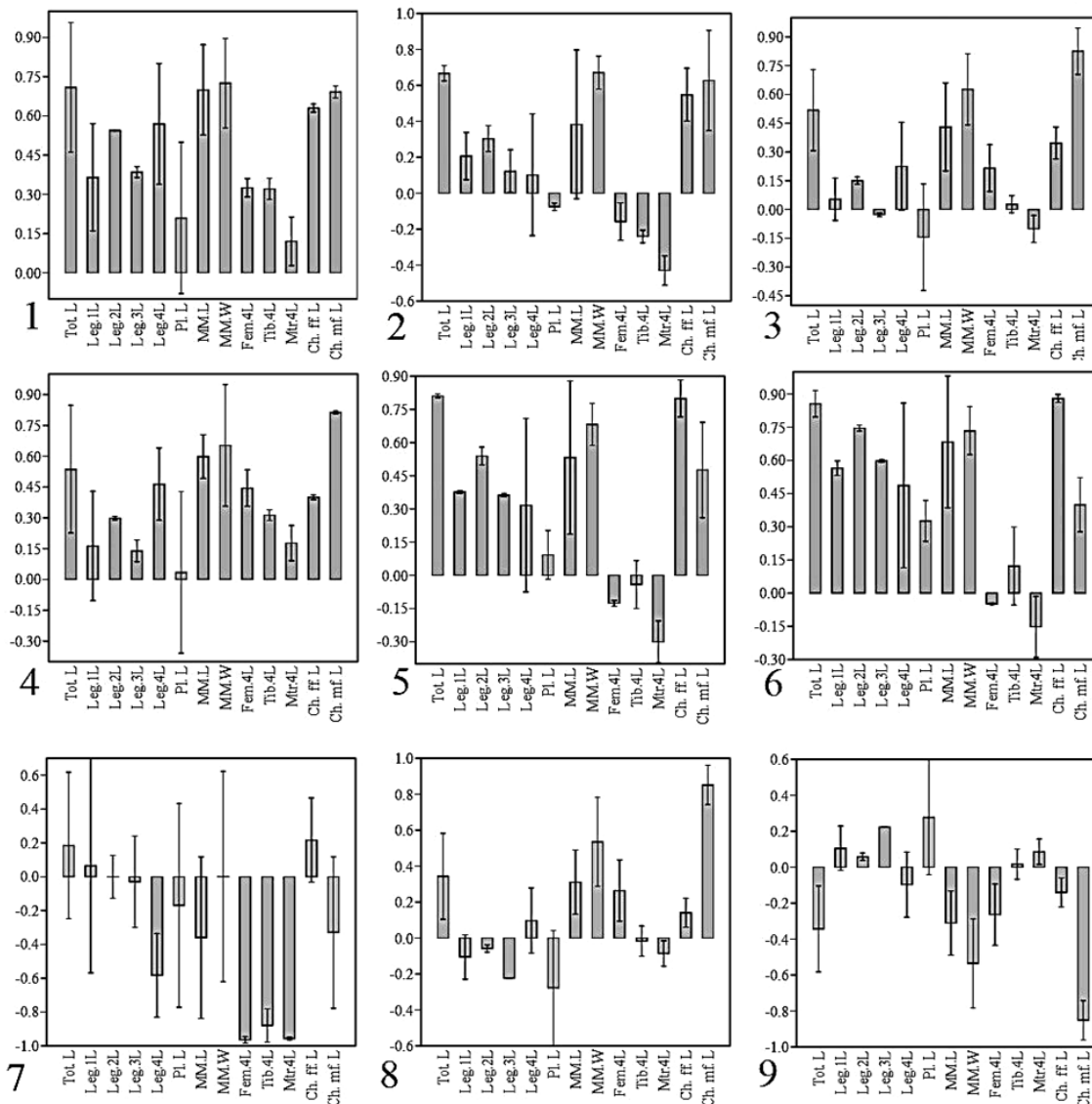


Fig. 4. Correlations between metric traits and some life-history parameters of solpugids: 1. number of eggs in a clutch. 2. density, ind./ha. 3. average weight of food eaten. 4. width of the trophic niche. 5. intensity of movements, average distance (m) covered during the period of night activity. 6. average speed of movement (cm/sec). 7. sex ratio. 8. seasonal activity (days). 9. duration of wintering (days).

So, for example, body length (Tot.L) positively correlated with clutch size ($r = 0.461-0.957$), cheliceral length (Ch.mf.L) – with the amount of food eaten relative to body weight ($r = 0.705-0.946$) and width of trophic niches ($r = 0.806-0.821$).

The relationship of size traits with such characteristics as the duration of seasonal activity and wintering, the daily rhythm of activity, and timing of reproduction was not obvious, since most traits were weakly correlated with these parameters. A strong positive correlation between the sums of the averages of all morphometric characters in males and females ($r = 0.610-0.940$) may indirectly indicate the adaptive nature of their

variability. The degree of divergence between different characters (male and female) may express their variability due to specific factors. For example, with a limited number of objects and predominantly specialized nutrition of males and hypertrophic nutrition and euryphagy of females (Wharton, 1987; Fairbairn, 1997). The role of the biological characteristics of each sex, determined by their reproductive function, cannot be excluded (Heymons, 1902; Junqua, 1962). In male solpugids these features are most manifested in the legs length trait Leg.(1-4), in females – in the length trait of the chelicerae (Ch.ff.L, Ch.mf.L) and opisthosoma (Ops.L).

Based on the totality of the data obtained from the entire volume of traits and indices, three groups of traits and indices were identified according to the criteria of their statistical reliability and high values of the dimorphism index (Fig. 5).

Size characters (indices) of high significance can be used together with key, meristic characters for diagnostic purposes in identifying sex and species; signs of average significance – when conducting morpho-ecological monitoring studies to compare the adaptive qualities of species.

Sexual differences in the overall body size of solpugids, by analogy with other orders of arachnids (Amblypygi & Scorpiones), can be explained by differences in the rate and duration of growth in nymphal ontogenesis fixed by sexual selection (McLean *et al.*, 2018, 2019). In the ontogenesis of solpugids, the stages of egg and larva (postembryo), nymphal, preimaginal and imaginal stages are conventionally distinguished (Muma, 1966; Punzo, 1998). Moreover, the formation of dimensional sexual differences in galeodids occurs at the beginning of the nymphal stage. For example, nymphs of *G. araneoides* females begin to actively outstrip male nymphs in growth, which becomes noticeable after the 2nd moult at the stage of nymphal development (Aliev, 1984).

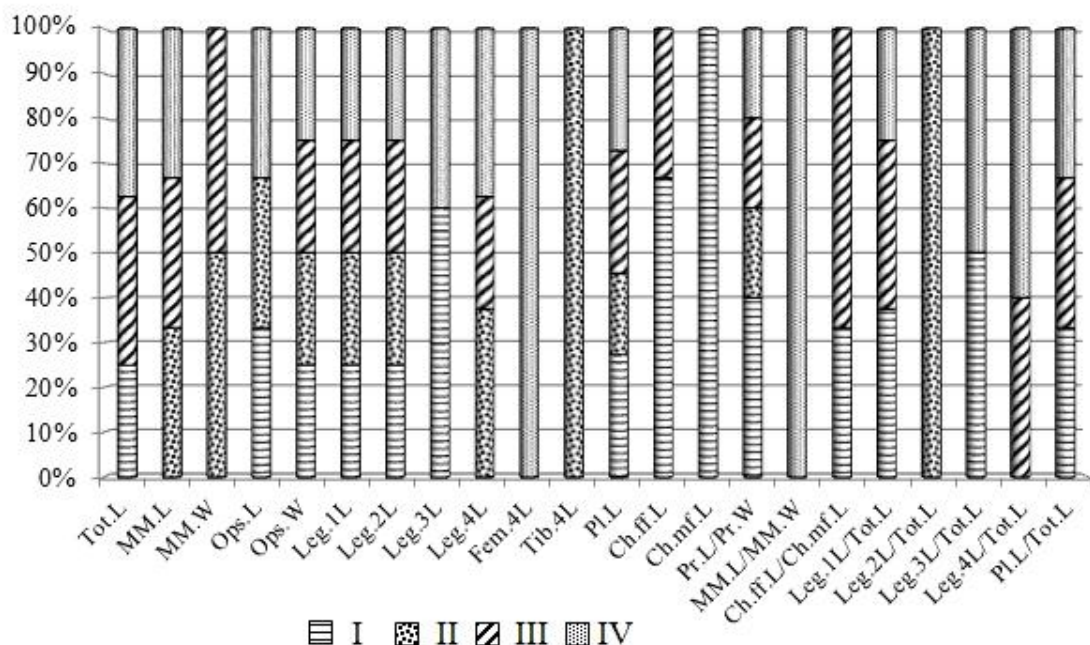


Fig. 5. Characters and indices of sexual dimorphism, identified according to the criterion of their significance: I = *G. araneoides*. II = *G. armeniacus*. III = *G. nachitschevanicus*. IV = *G. caspius*. (75-100% – significance level $p \leq 0.001$; 40-50% – significance level $p \leq 0.01$; 20-35% – significance level $p \leq 0.05$).

The similarity in the manifestation of sexual differences in some characters/indices (Tot.L, Leg.1L, Leg.4L, Pl.L, Pl.L/Tot.L) in two or several species may indicate the manifestation of sexual dimorphism resulting from sexual selection. The manifestation of more pronounced sex differences in size characteristics in one of the species (Leg.3L, Tib.4L, Ch.ff.L, Ch.mf.L, MM.L/MM.W) indicates the manifestation of morphofunctional variability associated with bioecological factors: a system of mating relations, ecological conditions of habitats, different metabolic rates and developmental features in the early stages of ontogenesis (Pianka, 1981). It is not possible to determine which of these versions is true within the framework of one study. Questions remain unclear about the patterns in the direction and severity of the manifestation of sexual differences in size characteristics depending on the age (nymphal stage) of solpugids. In addition, there are a number of unresolved questions regarding interpopulation and intrapopulation variability of intersexual differences in size traits, factors and mechanisms of its formation.

Males and females differ not only in their role in the reproductive process, but they can also develop fundamentally different survival strategies that increase the adaptability of the species as a whole. According to the literature, the size of the legs and pedipalps in males determines the success of finding a female, holding and manipulating her during the copulation process (Wharton, 1987; Punzo, 1998; Cushing *et al.*, 2014). The size of the chelicerae and opisthosoma in females provides greater opportunities for enhanced feeding, digging holes, and laying more eggs. All these traits together provide greater reproductive potential of the species (Punzo, 1998). Moreover, the proportions of individual indicated characteristics in both sexes can be maintained regardless of the overall body size (Tot.L).

In all samples, males showed an adaptive lengthening of the 4th pair of legs, probably associated with the need for increased locomotor activity in the process of searching for food objects and females for mating. In female solpugids (especially in *G. araneoides*), the chelicerae are more massive, longer and with well-developed teeth, which is presumably an adaptation to consuming objects with a denser exoskeleton and increased burrowing activity.

Prevalence in the length of walking legs (Leg.1-4L) and pedipalps (Pl.L) in males, and in terms of total body length (Tot.L), length/width of opisthosoma (Ops.L, Ops.W) and chelicerae (Ch.ff.L, Ch.mf.L) in females, may be due to their different type of nutrition and the specific participation of each sex in reproductive behaviour. Sexual dimorphism in chelicer size helps to separate the trophic niches of the two sexes, thereby reducing competition between them. Chelicerae are also the main tool of solpugids when digging holes, and the larger and more powerful they are the more effective their use for these purposes can be. Males dig mostly shallow and short burrows sufficient for their own safety. For female solpugids during the reproductive period, there is a need to dig longer and more spacious burrows to breed, preserve and protect future offspring.

Between the samples of *G. nachitschevanicus* and *G. armeniacus*, the variability of dimorphism characters is less pronounced than between the samples of *G. araneoides* and *G. caspius*, which may be due to the narrow biotopic and microstatial confinement of the first pair of species. Sexual differentiation in males, expressed in more elongated legs, probably as a consequence of their increased motor activity, in females in an increase in the relative length/width of the opisthosoma is due to the need for active feeding and gestation of eggs. Sexual dimorphism of males and females, manifested by differences in size characters, obviously increases the survival and reproductive success of solpugids, creates the opportunity for individuals to develop optimally and leave more offspring.

Conclusion

Males and females of four species of solpugids of the genus *Galeodes* from populations of the southeastern part of the Lesser Caucasus demonstrated interspecific differences in size traits and manifestations of sexual dimorphism in terms of size traits and indices of character ratios to varying degrees of severity. The species differed in the number of statistically significant characters and in the severity of their size differences, as indicated by the values of the dimorphism index (ID). Size sexual dimorphism was manifested in increasing order as follows: *G. armeniacus* (ID = 5.06), *G. nachitschevanicus* (ID = 6.33), *G. caspius* (ID = 16.15), *G. araneoides* (ID = 22.65) and is associated mainly with signs of the length of the legs, pedipalps and upper and lower fingers of the chelicerae, with indices of the ratio of the same signs to body length. The size characters of the length of walking legs in males of all four species of solpugids are significantly higher than in females. The size of the traits of the total length of the body and its individual parts is higher in females. All this may be associated with different types of nutrition (food acquisition strategy and its spectrum) and the specific participation of each sex in reproductive behaviour. Sexual differentiation of male solpugids, expressed in absolute and relative sizes of legs, provides high locomotor activity necessary for a more successful search for a female during the reproductive period, holding and manipulating a partner during copulation. The predominance in size of the chelicerae and the relative length and width of the opisthosoma in females is caused by the need for active feeding, digging more spacious burrows for bearing eggs and preserving the offspring. Obviously, such adaptations increase the survival and reproductive success of solpugids and create greater opportunities for the species to optimally develop and leave more offspring. The heterogeneity in the manifestation of size sexual dimorphism in different species of solpugids living in similar territories of the same geographical region is presumably associated with an adaptive-regulatory mechanism for maintaining the level of fertility, which determines different densities of their populations.

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First description of the female of *Odontodrassus aravaensis* from Egypt (Araneae: Gnaphosidae)

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Abstract

The female of the gnaphosid spider species *Odontodrassus aravaensis* Levy, 1999 is recorded for the first time from Egypt. This species is known from three countries based on male specimens only. The general habitus and genitalia of both male and female of this species are illustrated. Notes on the description, habitat, and collecting data of this species are also given.

Keywords: Araneae, Gnaphosidae, *Odontodrassus aravaensis*, new record, Egypt.

Introduction

Among the 153 genera of Family Gnaphosidae Banks, 1892, the sixth large family with 2475 species, genus *Odontodrassus* Jézéquel, 1965 is one of the small genera which includes only 8 species (World Spider Catalog, 2024).

In 1965, Jean-François Jézéquel described the new genus *Odontodrassus* to include two new species from Côte d'Ivoire (Ivory Coast) (Jézéquel, 1965: 296) [*Odontodrassus bicolor* and *O. nigriritibialis*]. The type species of this genus, *O. nigriritibialis*, is designated by Brignoli (1983: 574).

The name of *Odontodrassus* begins with the prefix: "**odonto-**" relating to teeth. "**la présence de nombreuses dents aux chélicères**" because chelicerae are armed with at least three teeth on the promargin and two teeth on the retromargin [Les *Odontodrassus* se caractérisent donc par **les chélicères armées d'au moins trois dents à la marge supérieure et deux dents à la marge inférieure** (Jézéquel, 1965)].

The eight species of genus *Odontodrassus* have a wide distribution from Morocco to Egypt, Palestine/Israel, Jordan, Iraq, Iran, Côte d'Ivoire (Ivory Coast), South Africa, Seychelles, Russia (Far East), Thailand, China, Korea, Japan, Indonesia (Sulawesi, Lombok), Myanmar to Philippines, New Caledonia, Pacific Is., Solomon Is., and introduced to Jamaica (World Spider Catalog, 2024).

All *Odontodrassus* species are known from both male and female except two species as follows:

- Genus *Odontodrassus* Jézéquel, 1965
Odontodrassus aphanes (Thorell, 1897) ♂♀ Myanmar to Philippines, Japan, New Caledonia, Solomon Is. Introduced to Jamaica, South Africa, Seychelles, Pacific Is.
Odontodrassus aravaensis Levy, 1999 ♂ Egypt, Palestine/Israel, Iraq
Odontodrassus bicolor Jézéquel, 1965 ♂♀ Côte d'Ivoire (Ivory Coast)
Odontodrassus hondoensis (Saito, 1939) ♂♀ Russia (Far East), China, Korea, Japan
Odontodrassus mundulus (O. Pickard-Cambridge, 1872) ♂♀ Morocco to Egypt, Palestine/Israel, Jordan, Iraq, Iran
Odontodrassus muralis Deeleman-Reinhold, 2001 ♀ Thailand, China, Indonesia (Sulawesi, Lombok)
Odontodrassus nigriritibialis Jézéquel, 1965 * ♂♀ Côte d'Ivoire (Ivory Coast)
Odontodrassus yunnanensis (Schenkel, 1963) ♂♀ China

The species of *Odontodrassus* are "displaying a disjunct distribution: four species have been reported from West and North Africa and the Middle East, while others are known from the Oriental realm, Eastern Palearctic and a few South Pacific islands" (Zamani *et al.*, 2022).

For diagnosis and description of genus *Odontodrassus* see: Jézéquel (1965: 296), Levy (1999: 448), and Deeleman-Reinhold (2001: 529-530).

Family Gnaphosidae is represented in the Egyptian fauna by 52 species of 23 genera; it is the second big family of spiders in Egypt after Salticidae and before Lycosidae (El-Hennawy, 2017; El-Hennawy *et al.*, 2020, 2021; El-Gendy, 2022).

Genus *Odontodrassus* is represented in Egypt by two species (El-Hennawy, 2017):
Odontodrassus aravaensis Levy, 1999 --- Ismailia
Odontodrassus mundulus (O. Pickard-Cambridge, 1872) --- Cairo, southern Sinai

O. aravaensis was recorded from Serabium region (Ismailia governorate) by Doaa Medany (2013). This record was published by El-Hennawy (2017) based on male specimens only. Later, Maryham Sawers (2023) recorded *O. aravaensis* from orchards of Plum and Pecan trees in the Experimental Station of the Faculty of Agriculture, Cairo University, Giza Governorate.

Females of *O. aravaensis* were not identified before. Therefore, we present here the first description of the female of *Odontodrassus aravaensis* Levy, 1999 from Serabium region, Ismailia governorate, Egypt with notes and illustrations of both male and female of this species.

Material and Methods

The study area, Serabium forest, about 16 km south of Ismailia, was established in 1998 and its cultivation process began in 2002 with 16 introduced tree species over nearly 600 feddans (Fig. 1). All productive trees were cultivated as patches of monoculture canopies. It is a part of the national Egyptian programme for safe use of treated sewage water for afforestation project to develop an innovative afforestation

approach using water unsuitable for human direct or indirect consumption on unproductive land (Medany, 2013).

These tree canopies with their accumulated litter attracted insects and their predators of spiders and other arthropods. Hence, spiders were studied in woody forest plantation in Serabium region, Ismailia governorate, as bioindicator for environmental risk assessment by Doaa Medany (2013). That study included 3217 individuals of 106 spider species that belong to 58 genera and 26 families, collected from six canopy species.

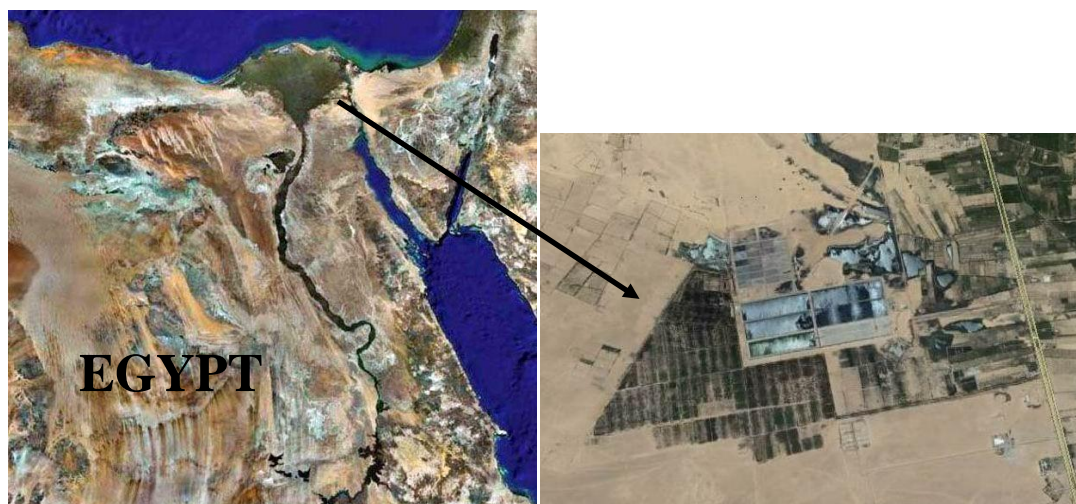


Fig. 1. Collecting site in Serabium region beside the sewage treatment station of Ismailia, Egypt.

Note. The most species-rich family was Gnaphosidae (17 species) that was the most abundant and diverse family in the forest habitat too. During this study, five spider species were newly recorded in Egypt (Medany, 2013; El-Hennawy *et al.*, 2012; El-Hennawy, 2017), two of them are gnaphosids: *Micaria dives* (Lucas, 1846) and *Odontodrassus aravaensis* Levy, 1999. Hence, Serabium forest looks promising to look for spiders among its trees. Later, as a result of new collecting activity in the same region, *Zelotes tragicus* (O. Pickard-Cambridge, 1872) and *Minosiella pallida* (L. Koch, 1875) were recorded too (El-Hennawy *et al.*, 2020, 2021).

Collecting spiders was done mostly by hand (Hand collecting) and sometimes by pitfall traps (Pitfall trapping), once a month, during the period from January to October 2019, preceded by two preliminary trips in July and September 2018.



Fig. 2. Trees cultivated in Serabium region near the sewage treatment station of Ismailia. A. Khaya wood, *Khaya senegalensis*. B. Lemon-scented gum, *Corymbia citriodora*. (After Medany, 2013: 44, 47)

In this new study, the female of *Odontodrassus aravaensis* Levy, 1999 is recorded for the first time. *O. aravaensis* was found only in the areas of two kinds of trees:

1- *Khaya senegalensis* (Desr.) A. Juss. Common names include African mahogany and khaya wood [كاي] (Fig. 2A).

2- *Corymbia citriodora* (Hooker, 1848) Hill & Johnson, 1995 commonly known as lemon-scented gum or spotted gum [كافور ليموني] (Fig. 2B).

Abbreviations used: AL = abdomen length, CL = cephalothorax length, CW = cephalothorax width, d = dorsal, Fe = femur, Mt = metatarsus, Pa = patella, pl = prolateral, Ta = tarsus, Ti = tibia, TL = total length, v = ventral.

All measurements were taken in millimetres.

Results and Discussion

Family **Gnaphosidae** Banks, 1892

Genus *Odontodrassus* Jézéquel, 1965

Odontodrassus aravaensis Levy, 1999

(Figs. 3-25)

Odontodrassus aravaensis Levy, 1999: 450-451, f. 41-42, 47-49 (D♂).

Odontodrassus aravaensis El-Hennawy, 2017: 171-172, f. 1-3 (♂).

Odontodrassus aravaensis Zamani, Al-Yacoub & Najim, 2022:144-146, f. 1D, 2B, 3A (♂).

Distribution: Egypt (Ismailia and Giza governorates), Iraq (Thi Qar Province), Palestine/Israel (Qetura, Arava Valley).

Material examined: 1♂, 8♀♀, 23 June 2019, among *Khaya senegalensis* trees; 1♂, 1♀, 17 February 2019, among *Khaya* trees beside lemon-scented gum trees. Egypt, Ismailia governorate, near Ismailia (about 30°29'27"N, 32°14'29"E, elevation 10 m). Collected by Gihan Sallam, Nahla Abd El-Azim & Hazem Abul Fadl. All specimens were collected by hand except the male of 23 June 2019 by a pitfall trap [partly decayed].

Description: The male of this species was described once by Levy (1999) with measurements and illustrations of the holotype from Qetura, Arava Valley. Later, the habitus and palpal organ of males from Egypt and Iraq were illustrated without descriptions (El-Hennawy, 2017; Zamani *et al.*, 2022).

♂

Colouration: Cephalothorax brown with blackish border. Legs almost brown with blackish tibiae and dark metatarsi. Abdomen yellow with dorsal black chevrons; its ventral side (Venter) with two black triangles anterior to spinnerets (Figs. 3-5).

Measurements: (1♂) TL 4.11, CL 2.11, CW 1.67, AL 2.00 [Levy (1999): TL 4.7, CL 2.4, CW 1.8].

Table 1. Measurements of leg segments of *Odontodrassus aravaensis* ♂.

| Legs | Fe | Pa | Ti | Mt | Ta | TL |
|------|------|------|------|------|------|------|
| I | 1.56 | 1.04 | 1.31 | 1.00 | 0.73 | 5.64 |
| II | 1.35 | 0.80 | 1.06 | 0.90 | 0.52 | 4.63 |
| III | 1.20 | 0.60 | 0.83 | 1.04 | 0.62 | 4.29 |
| IV | 1.70 | 0.90 | 1.35 | 1.77 | 0.73 | 6.45 |



3



4

Figs. 3-13. *Odontodrassus aravaensis* Levy, 1999 ♂. 3-4. Habitus. 3. dorsal view. 4. ventral view.



5



6

5. Cephalothorax, dorsal view. 6. Abdomen of a decayed specimen, dorsal view, showing triangular scutum.

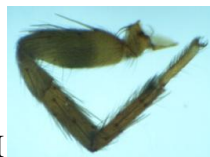


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I



II

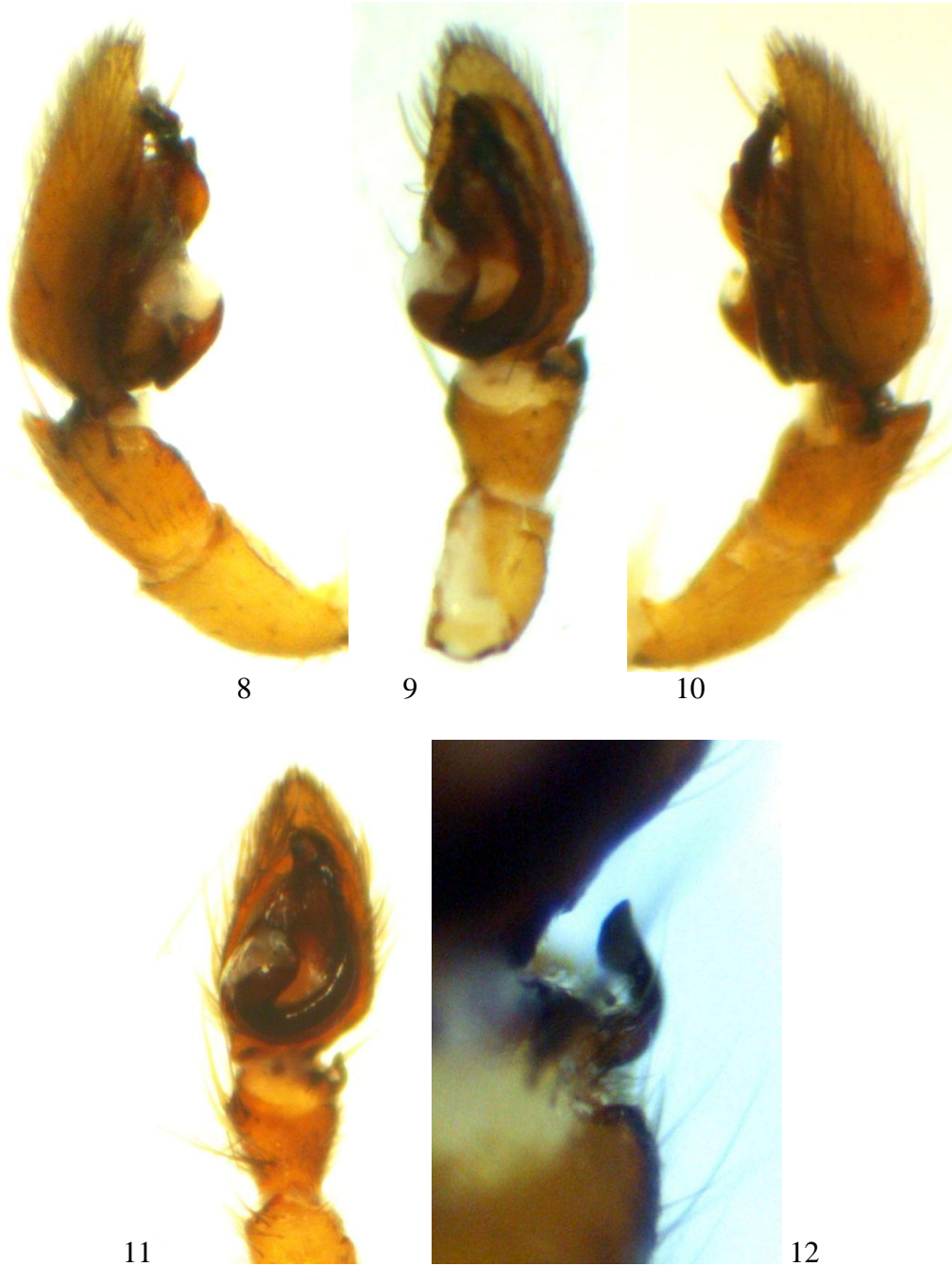


III



IV

7. Legs I-IV, lateral view, showing spines.



8-12. Left palp. 8. prolateral view. 9, 11. ventral view. 10. retrolateral view. 12. retrolateral apophysis on tibia, enlarged.



13. Chelicerae, showing promarginal and retromarginal teeth.

Leg formula: 4-1-2-3.

Spination: I Fe d 1-1-0, pl 0-0-1, II Fe d 1-1-0, pl 0-0-1, Ti v 1-1-0, III, IV numerous Fe, Pa, Ti, Mt (Fig. 7).

Carapace index (CL/CW) = 1.26, Patella-tibia index (Pa-Ti I/CL) = 1.11 [Levy (1999): carapace index 1.33; patella-tibia index 0.96].

Chelicerae with 3 promarginal and 2 retromarginal teeth (Fig. 13).

Male palp as in Figs. (8-11), it is similar to that described by Levy (1999) especially "the unique shape of the tibial retrolateral apophysis (Fig. 12).

♀

Colouration: Similar to male, but dorsal black chevrons and ventral triangles lighter in colour (Figs. 14-18).

Legs only I Pa-Ti-Mt blackish.

Measurements: (8♀♀) TL 4.22 - 4.67 - 4.78 - 5.22 - 5.33 - 5.44 - 5.67 - 6.11; av. 5.18.

Biggest specimen: TL 6.11, CL 2.78, CW 2.2, AL 3.22.

Table 2. Measurements of leg segments of *Odontodrassus aravaensis* ♀.

| Legs | Fe | Pa | Ti | Mt | Ta | TL |
|------|------|------|------|------|------|------|
| I | 1.77 | 1.04 | 1.46 | 0.94 | 0.77 | 5.98 |
| II | 1.56 | 0.83 | 1.25 | 0.94 | 0.75 | 5.33 |
| III | 1.35 | 0.73 | 0.83 | 1.15 | 0.69 | 4.75 |
| IV | 1.88 | 0.94 | 1.67 | 2.08 | 0.90 | 7.47 |

Leg formula: 4-1-2-3.

Spination: I Fe d 1-0-0, II Fe d 1-1-0 Pa d 0-1-1, III numerous Fe, Ti, Mt, IV numerous Fe, Pa, Ti, Mt (Fig. 19).

Tarsus IV and claws (Fig. 20).

Carapace index (CL/CW) = 1.26, Patella-tibia index (Pa-Ti I/CL) = 0.90.

Female epigynum and vulva as in Figs. (21-25).

*** There is a small triangular scutum on the anterior part of the dorsal side of the male's abdomen (Fig. 6) on the contrary of Levy (1999).

Murphy (2007) classified genus *Odontodrassus* in group *Echemus* "which generally possess dorsally plain-coloured abdomens - typically greyish, tawny or brownish - but occasionally with darker chevrons posteriorly, and **whose males possess a dorsal scutum**". He stated that: "So far, in the specimens examined, no genus has provided males both with and without a developed dorsal scutum. However, Levy (1999) stated that *Odontodrassus aravaensis* lacks a scutum, whilst *O. mundulus* has a scutum. Certainly all the male *Odontodrassus* specimens examined here (including *O. mundulus*) had a developed scutum. The shape and colouring of the relevant area figured for *O. aravaensis* by Levy suggest that a scutum could be present, but hidden by thick, dark hair. It would certainly be of interest to know if this species genuinely lacks a scutum."

The single male holotype examined by Levy (1999) and its illustrated abdomen (Fig. 41) and the recent illustration by Zamani *et al.* (2022: Fig. 1D) suggest the presence of a small scutum appears like a shadow. This is confirmed by our decayed specimen (Fig. 6) and by Fig. (3) too.



14



15

Figs. 14-25. *Odontodrassus aravaensis* Levy, 1999 ♀, habitus. 14. dorsal view. 15. ventral view.

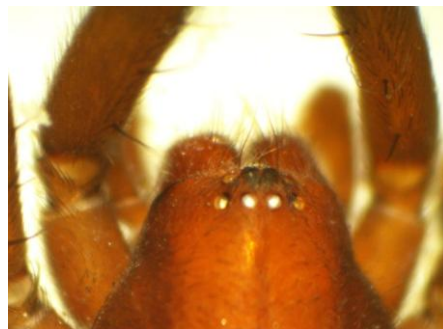


16



17

16. Cephalothorax, dorsal view. 17. Abdomen, dorsal view.



18. Eyes, dorsal view.



19. Legs I-IV, lateral view, showing spines.



20. Tarsus IV, lateral view.



21



22

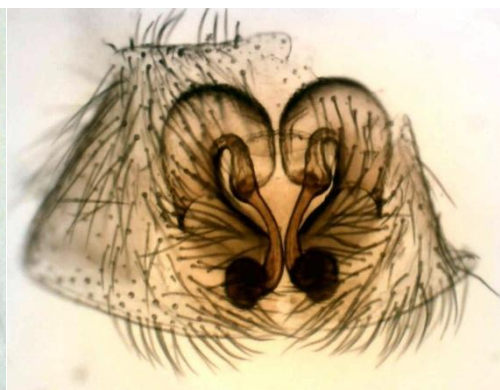


23

21-23. Epigynum, ventral view (3 specimens).



24



25

24-25. Vulva, cleared. 24. ventral view. 25. dorsal view.

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An overview on diversity and distribution of scorpion fauna in Madhya Pradesh and Chhattisgarh, Central India with four new records from Chhattisgarh

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Abstract

The present study provides a detailed checklist of the scorpion fauna of Central India and their distribution on the Indian subcontinent. The study brings four new records from the state of Chhattisgarh along with their morphology.

Keywords: Distribution, new record, scorpion, taxonomy, India.

Introduction

Scorpions are among the most ancient terrestrial arthropods, derived from amphibious ancestors that lived in the Middle Silurian, around 425 million years ago (Lourenço, 2016) and play a major role as dominant predators by controlling the invertebrate population in the arid ecosystems and also serve themselves as a prey to other organisms (Prendini, 2012). Although scorpions have evolved from marine environments, they are abundant in arid areas, where their population biomass may exceed that of vertebrates (Lighton *et al.*, 2001). Based on the habitats preferred by

them, scorpions are classified as burrowing (psammophilous or pelophilous), rock dwelling (lithophilous), arboreal and leaf-litter dwelling (Polis, 1990).

However, there is not an accepted definition of Central India in geographic sense. Here, the states of Madhya Pradesh and Chhattisgarh were considered as Central India based on similar climatic and physiographic conditions (Champion & Seth, 1968; Mani, 1974) to review the diversity and distribution of scorpion fauna. The region majorly comprises two biogeographic zones i.e., Semi-arid and Deccan peninsula (Rodger *et al.*, 2000).

There is a lack of a comprehensive work on the scorpions in Central India. The first ever species described from Mandla, Raipur, Bhopal and Gwalior in Central Indian Province were *Buthus pachyurus*, *Archisometrus rugosus*, *Isometrus rigidulus*, and *Palamnaeus liurus* respectively by Pocock (1897). Later four species were added to the list (Pocock, 1900; Bastawade, 1992; Kovařík, 2007; Lourenço, 2012). The first compiled information on scorpion diversity in Madhya Pradesh was made available by Chandra *et al.* (2010), enlisting 10 species which was later revised by Bastawade *et al.* (2012) taking the species count to 18 species from this state. Further, the information on scorpion diversity in three Protected Areas of Madhya Pradesh viz. Veerangana, Shingori and Nauradehi Wildlife Sanctuaries was brought into knowledge by Patil *et al.* (2016 a,b) and Mohapatra *et al.* (2022). The scorpion diversity of Madhya Pradesh also accounts for three endemic species namely *Hottentotta jabalpurensis*, *Scorpiops pachmarhicus*, and *Deccanometrus liurus*. The scorpion fauna of Chhattisgarh comprises first reporting of *Liocheles nigripes* by Zambre & Patil (2011) from the state, to which Bastawade *et al.* (2012) added two species viz. *Reddyanus assamensis* and *Lychas rugosus*. Later, Prendini & Loria (2020) reported three species viz. *Chersonesometrus madraspatensis*, *Deccanometrus phipsoni*, and *Gigantometrus swammerdami* from the state.

A detailed bionomics of an endemic scorpion in Central India was brought into knowledge by Pandey *et al.* (2021). The present study provides a detailed checklist of the scorpion fauna of Central India and their distribution in the Indian subcontinent along with four new records from the state of Chhattisgarh.

Material and Methods

This study was undertaken at Zoological Survey of India (ZSI), Central Zone Regional Centre (CZRC), Jabalpur, Madhya Pradesh and Guru Gobind Singh Indraprastha University, New Delhi. The specimens were measured using Mitutoyo™ digital callipers to the nearest 0.1 mm. Photographs were taken in field to see the natural colouration and in laboratory images of the specimens were taken under Leica M205FA stereo zoom microscope using UV light. Distribution localities of the species were recorded based on the meta-data available for the specimens housed in the national zoological collections of ZSI, CZRC and through review of available literature. Each specimen was identified by evaluating standard taxonomic characters in a datasheet to record quantitative (i.e., mensural and meristic) and qualitative taxonomic characters following standard taxonomic keys (Tikader & Bastawade, 1983; Kovařík, 2007; Prendini & Loria, 2020).

Abbreviations used: AC = Anterior carapace, AL = Aculeus length, AW = Anterior width, CL = Carapace length, FeD = Femur depth, FeL = Femur length, FeW = Femur width, FFL = Fixed finger length, GOL = Genital operculum length, GOW = Genital operculum width, LE = Lateral eye, ME = Median eye, MesL = Mesosoma length, Met-

I-H = Metasoma-I height, Met-I-L = Metasoma-I length, Met-I-W = Metasoma-I width, Met-II-H = Metasoma-II height, Met-II-L = Metasoma-II length, Met-II-W = Metasoma-II width, Met-III-H = Metasoma-III height, Met-III-L = Metasoma-III length, Met-III-W = Metasoma-III width, Met-IV-H = Metasoma-IV height, Met-IV-L = Metasoma-IV length, Met-IV-W = Metasoma-IV width, Met-V-H = Metasoma-V height, Met-V-L = Metasoma-V length, Met-V-W = Metasoma-V width, MFL = Movable finger length, MnH = Manus height, MnL = Manus length, MnW = Manus width, MTL = Metasoma total length, MW = Median width, PatD = Patella depth, PatL = Patella length, PatW = Patella width, PC = Posterior carapace, PecL = Pecten length, PecW = Pecten width, PedL = Pedipalp length, PP = Pragma Pandey, PT-L/R = Pectinal teeth left/right, PW = Posterior width, TeH = Telson height, TeL = Telson length, TeW = Telson width, Ti/C-L = Tibia/Chela length, TL = Total length, VL = Vesicle length.

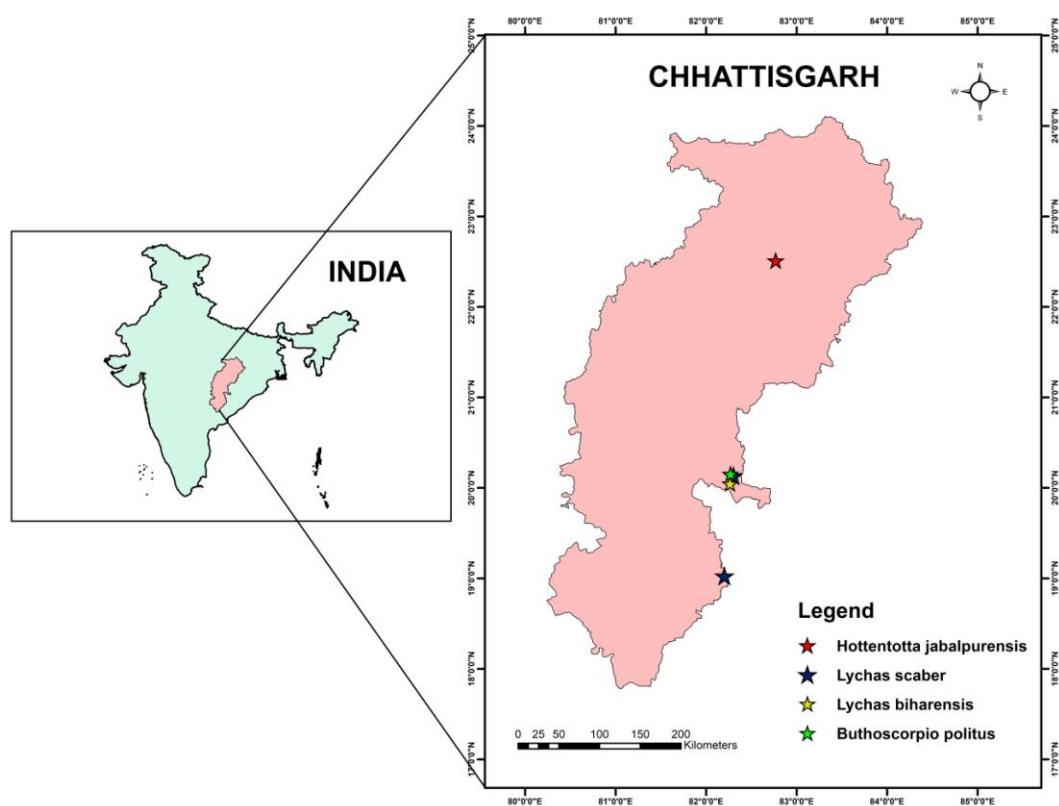


Fig. 1. Locality record of *Hottentotta jabalpurensis*, *Lychas scaber*, *Lychas biharensis*, and *Buthoscorpio politus* in Chhattisgarh.

Results

A total of 22 species of scorpions (18 from Madhya Pradesh and 10 from Chhattisgarh) belonging to four families and 11 genera were recorded from central India during present study. A detailed morphometric characteristics, description and distribution of these species are provided below.

New records from the state of Chhattisgarh

Order Scorpiones

Family **Buthidae** C.L. Koch, 1837

Genus **Buthoscorpio** Werner, 1936

1. *Buthoscorpio politus* (Pocock, 1899) (Figs. 1, 2, 6A)

Material examined: One ♀ (ZSI/CZRC/A-21327), Gariabandh, Jharia/Bahara. Toranga range. Udanti TR.

Identification: Total length 23.1 mm in female. Colouration entirely brownish black. Carapace almost smooth, flat, subrectangular with concave anterior margin, longer and posteriorly wider than all the metasomal segments. Median eyes are situated anteriorly in the ratio 1:2.9. Mesosoma smooth. Legs paler than the body, smooth; Tail robust, more than three times as long as the carapace, thicker at the base; entirely punctated; telson smaller than the carapace with vesicle is longer than the aculeus in the ratio 1:2.9. Fingers of chela slender, longer and darker distally with movable imbricated and outer row comprises of ten teeth; Patella smaller than fifth metasomal segment. Pectinal teeth count 17/16.

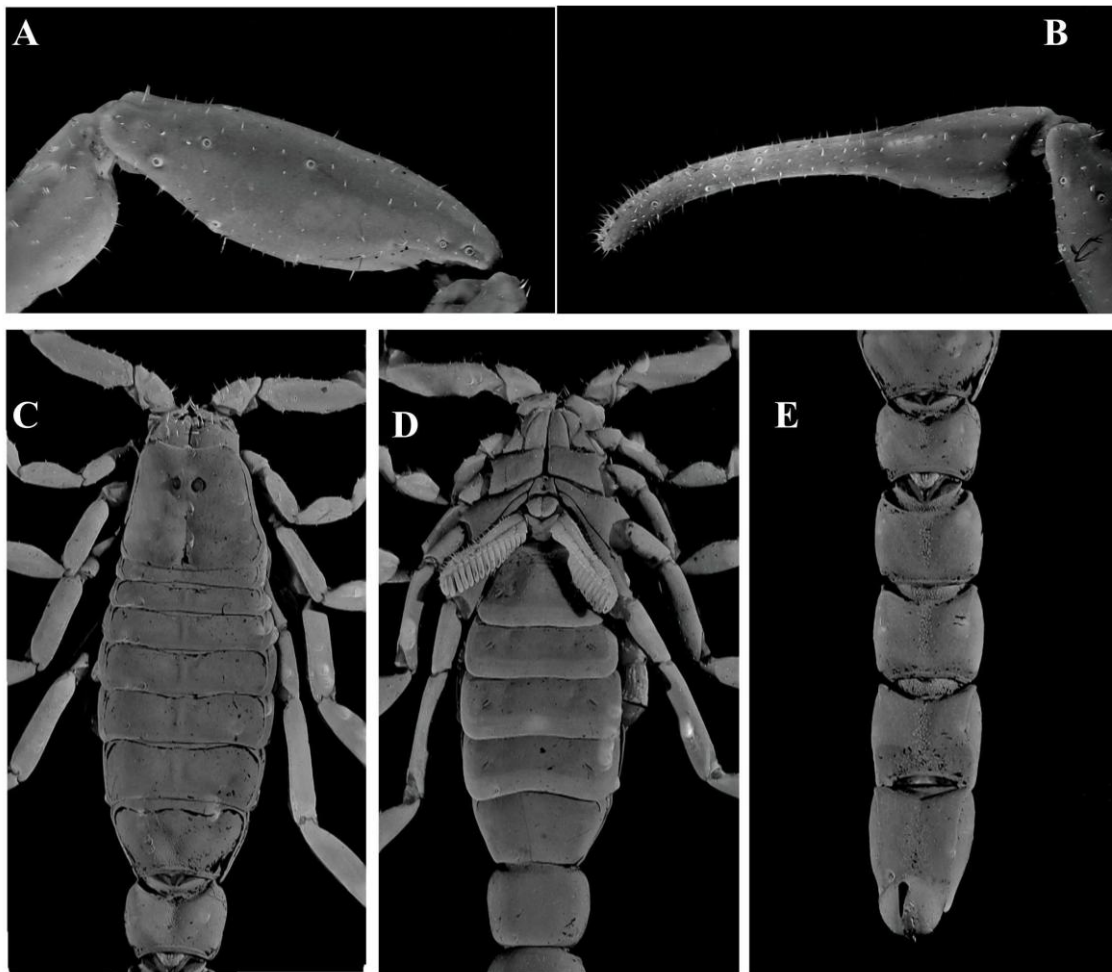


Fig. 2. *Buthoscorpio politus*. A. Dorsal view of patella. B. Dorsal view of manus. C. Dorsal view of carapace and mesosoma. D. Ventral view of prosoma and mesosoma. E. Dorsal view of metasoma.

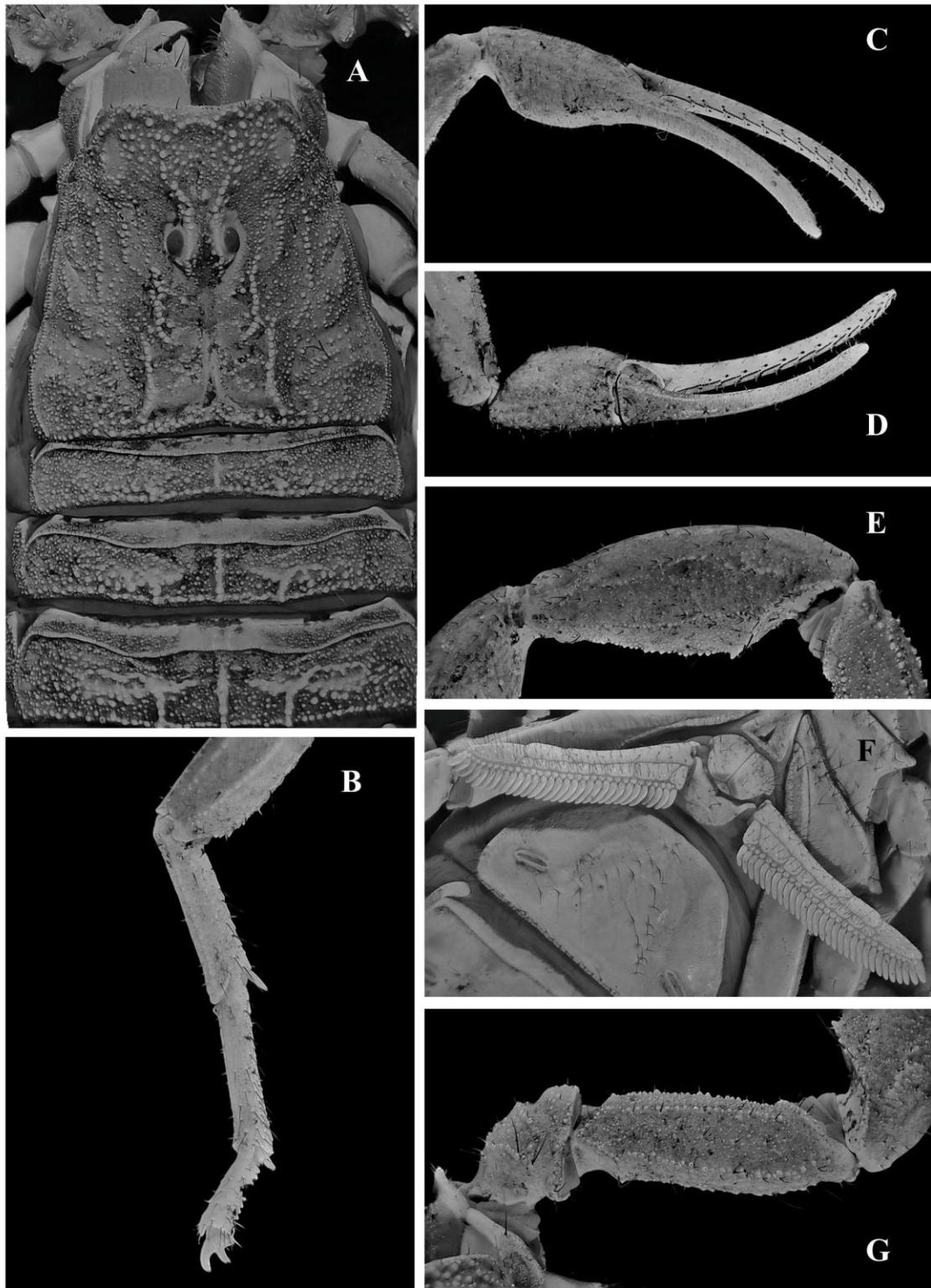


Fig. 3. *Hottentotta jabalpurensis*. A. Carapace. B. 4th leg. C. Movable finger. D. Immovable finger. E. Dorsal view of patella. F. Pectines. G. Dorsal view of femur.

Genus *Hottentotta* Birula, 1908

2. *Hottentotta jabalpurensis* Kovařík, 2007 (Figs. 1, 3, 6C)

Material examined: One ♂ (ZSI/CZRC/A-21731), Dudhianagar to Hamumar, Putka Pahad, Korba district and one ♀ (ZSI/CZRC/A-21334), Putka Pahad, Korba District.

Identification: Total length 43.72 mm in male and 52.45 mm in female. Colouration is uniformly yellow to reddish brown. Carapace entirely finely granular, subrectangular, longer and posteriorly wider than all the metasomal segments. Median eye is situated anteriorly in the ratio 1:2.9. Legs paler than the entire body. Mesosoma entirely granular, tricarinated. Tail robust, entirely granular with metasomal segment I wider than long; telson with vesicle longer in the ratio 1:1.7. Pectinal teeth 27/27 in male and 26/26 in female. Manus more robust and wider in male than female; Chela smooth, fingers slender longer and darker distally; Movable fingers with 13-14 cutting rows of granules and 5 or 6 terminal granules; Patella longer than the femur but smaller than the fifth metasomal segment.

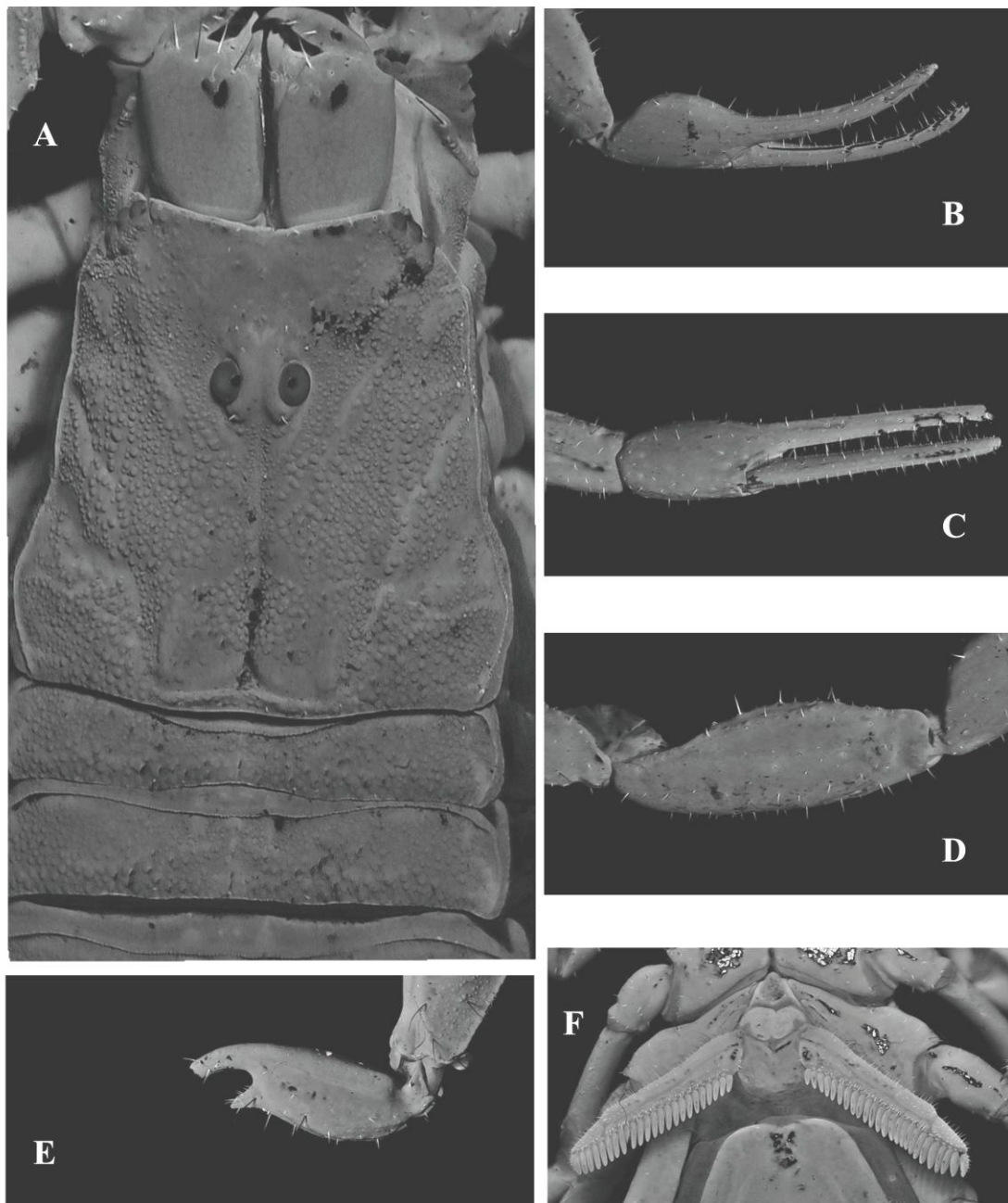


Fig. 4. *Lychas biharensis*. A. Carapace. B. Movable finger. C. Exterior view of manus. D. Dorsal view of patella. E. Telson. F. Pectines.

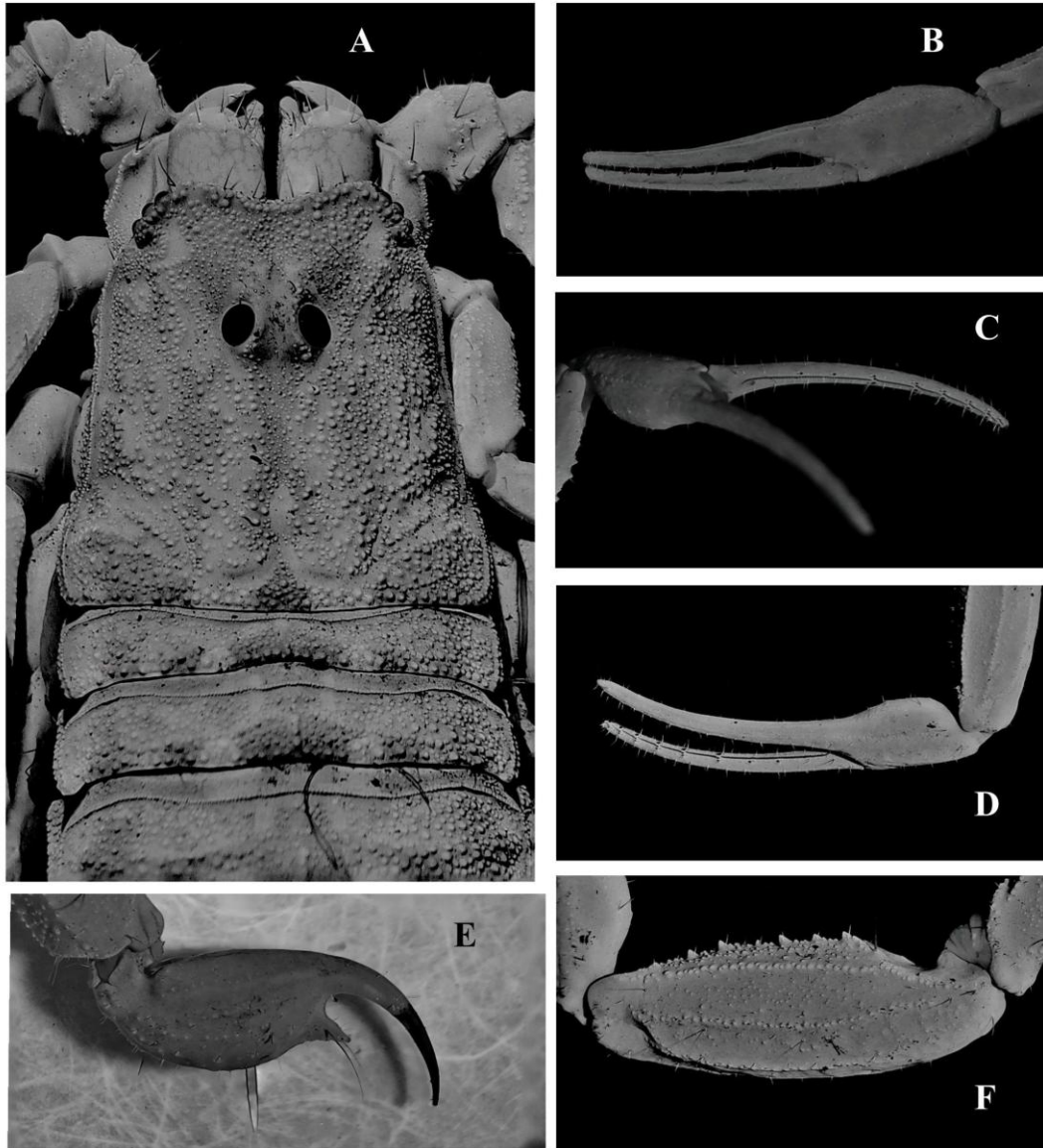


Fig. 5. *Lychas scaber*. A. Carapace. B. Exterior view of manus. C. Movable finger. D. Dorsal view of manus. E. Telson. F. Dorsal view of patella.

Genus *Lychas* C.L. Koch, 1845

3. *Lychas biharensis* Tikader & Bastawade, 1983 (Figs. 1, 4)

Material examined: One ♀ (ZSI/CZRC/A-21333), South Karrajhar, Udanti TR.

Identification: Total length 38.75 in female. Colouration entirely reddish brown with yellow patches. Carapace granular, lacking distinct carinae, flat, subrectangular with concave anterior margin; longer and posteriorly wider than the first metasomal segment. Median eyes are situated anteriorly in the ratio 1:2.2. Mesosoma entirely granular. Legs colour paler than the body, tibia carinated with smooth carinae. Tail slender but robust, more than five times as long as carapace. Telson ellipsoidal in shape, with distinct triangular subaculear tooth; longer than the carapace but shorter than the fifth metasomal segment. Vesicle is longer than the aculeus in the ratio 1:1.2. Pedipalp dark brown with chela reddish brown distally. Fingers of not much long and slender with sixth cutting edge on movable finger without external and internal granules. Pectinal teeth 23/25 in female.

4. *Lychas scaber* (Pocock, 1893) (Figs. 1, 5, 7B)

Material examined: Two ♂♂ (ZSI/CZRC/A-22522), Machhkot forest Jagdalpur, ZSI/CZRC/A-22525), Gariabandh, Gobra, Mainpur, Udanti Sita Nagar TR.

Identification: Total length 37.89-39.86 mm in males. Colouration entirely yellow with brown patches. Carapace granular, lacking distinct carinae, flat, subrectangular with concave anterior margin, longer and posteriorly wider than the first metasomal segment. Median eyes are situated anteriorly in the ratio 1:3. Carapace and mesosoma sparsely granular on the dorsal surface. Legs paler than the body, carinated, intercarinal space granular. Tail moderately robust; 5-6 times as long as the carapace in males and 4-5 times as long as carapace in females (in literature); thicker at the base; moderately excavated above; the inter-carinal spaces granular; Telson ellipsoidal in shape, with distinct triangular subaculear tooth; longer than the carapace but shorter than the fifth metasomal segment. Vesicle is longer than the aculeus in the ratio 1:2.1 in males and 1:1.6 in females. Fingers of chela longer and darker distally with sixth cutting edges on movable and fixed fingers of pedipalps each with two external granules. Pectinal teeth count 18/21 in male and female.

Diversity

Systematics

Class **Arachnida**

Order **Scorpiones**

Family **Buthidae** C.L. Koch, 1837

Genus *Buthoscorpio* Werner, 1936

1. *Buthoscorpio indicus* Lourenço, 2012

Type locality: Madhya Pradesh: Between Jabalpur and Khajuraho.

Distribution: Madhya Pradesh, Kerala (Lourenço, 2012; Aswathi *et al.*, 2016).

2. *Buthoscorpio politus* (Pocock, 1899) (Figs. 1, 2, 6A)

Type locality: Madhya Pradesh: Between Jabalpur and Khajuraho.

Distribution: Madhya Pradesh, Odisha, Kerala (Pocock, 1899; Pocock, 1900; Tikader & Bastawade, 1983; Bastawade *et al.*, 2012), Chhattisgarh (present report).

Genus *Compsobuthus* Vachon, 1949

3. *Compsobuthus rugosulus* (Pocock, 1900) (Fig. 6B)

Type locality: Madhya Pradesh: Gwalior.

Distribution: Madhya Pradesh, Rajasthan, Gujarat (Pocock, 1900; Lourenco & Monod, 1998; Bastawade *et al.*, 2012; Mohapatra *et al.*, 2022); Elsewhere: Pakistan.

Genus *Hottentotta* Birula, 1908

4. *Hottentotta jabalpurensis* Kovařík, 2007 (Figs. 1, 3, 6C)

Type locality: Madhya Pradesh: Jabalpur.

Distribution: Madhya Pradesh (Kovařík, 2007; Bastawade *et al.*, 2012; Pandey *et al.*, 2021; Mohapatra *et al.*, 2022), Chhattisgarh (present report).

5. *Hottentotta pachyurus* (Pocock, 1897) (Fig. 6D)

Type locality: Madhya Pradesh: Mandla, Central Province.

Distribution: Madhya Pradesh, Maharashtra, Tamil Nadu (Pocock, 1897; Mirza *et al.*, 2009; Bastawade *et al.*, 2012).

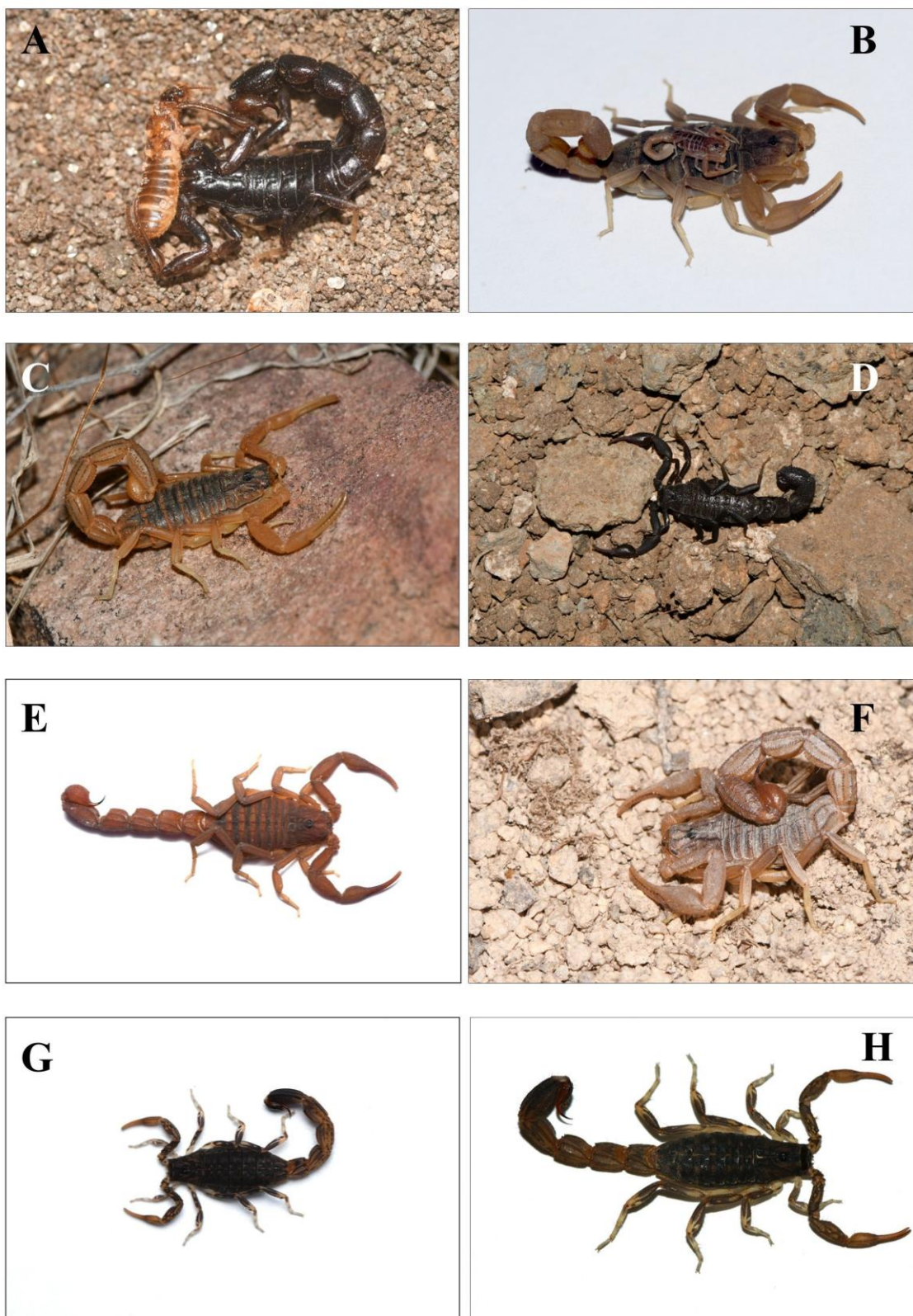


Fig. 6. Field photos: A. *Buthoscorpio politus*. B. *Compsobuthus rugosulus*. C. *Hottentotta jabalpurensis*. D. *Hottentotta pachyurus*. E. *Hottentotta rugiscutis*. F. *Hottentotta tamulus*. G. *Janalychas laevifrons*. H. *Janalychas tricarinatus*.

6. *Hottentotta rugiscutis* (Pocock, 1897) (Fig. 6E)

Type locality: Maharashtra: Mahabaleshwar, Satara.

Distribution: Andhra Pradesh, Goa, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, Pondicherry, West Bengal, Telangana (Pocock, 1900; Kovařík, 2007; Bastawade *et al.*, 2012).

7. *Hottentotta tamulus* (Fabricius, 1798) (Fig. 6F)

Type locality: Maharashtra: Mumbai (Neotype by Kovařík, 2007).

Distribution: Gujarat; Uttarakhand, Maharashtra, Andhra Pradesh, Bihar, Jharkhand, Madhya Pradesh, Pondicherry, Rajasthan, Tamil Nadu, West Bengal, Goa, Uttar Pradesh, Telangana (Pocock, 1900; Kovařík, 2007; Bastawade *et al.*, 2012; Mohapatra *et al.*, 2022); Elsewhere: Pakistan.

Genus *Janalychas* Kovařík, 2019

8. *Janalychas laevifrons* (Pocock, 1897) (Fig. 6G)

Type locality: West Bengal: Kolkata.

Distribution: Madhya Pradesh, Kerala, Bihar, Gujarat, Maharashtra, West Bengal, Kerala (Tikader & Bastawade, 1983; Kovařík, 1997; Bastawade *et al.*, 2012; Aswathi & Sureshan, 2017; Kovařík, 2019; Mohapatra *et al.*, 2022).

9. *Janalychas tricarinatus* (Simon, 1884) (Fig. 6H)

Type locality: Gujarat: Panch Mahal.

Distribution: Gujarat, Karnataka, Pondicherry, Madhya Pradesh, Kerala, Andhra Pradesh, Tamil Nadu, Odisha, Telangana (Bastawade *et al.*, 2012; Kovařík, 2019; Mirza, 2020; Mohapatra, 2021; Mohapatra *et al.*, 2022).

Genus *Lychas* C.L. Koch, 1845

10. *Lychas biharensis* Tikader & Bastawade, 1983 (Figs. 1, 4)

Type locality: Bihar: Chaurasi (Manbhun).

Distribution: Bihar, Odisha (Tikader & Bastawade, 1983; Kovařík, 1997; Bastawade *et al.*, 2012; Aswathi *et al.*, 2016; Kovařík, 2019), Chhattisgarh (present report).

11. *Lychas rugosus* (Pocock, 1897)

Type locality: Chhattisgarh: Raipur.

Distribution: Chhattisgarh, Maharashtra (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 1997; Bastawade *et al.*, 2012; Kovařík, 2019).

12. *Lychas scaber* (Pocock, 1893) (Figs. 1, 5, 7B)

Type locality: Telangana: Secundrabad.

Distribution: Andhra Pradesh, Tamil Nadu, Telangana (Pocock 1900; Gravely, 1921; Tikader & Bastawade, 1983; Kovařík, 1997; Bastawade *et al.*, 2012; Kovařík, 2019, Mohapatra *et al.*, 2022), Chhattisgarh (present report).

Genus *Reddyanus* Vachon, 1972

13. *Reddyanus assamensis* (Oates, 1888) (Fig. 7A)

Type locality: Assam: Dhubri.

Distribution: Assam, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Uttarakhand, West Bengal, Odisha (Kraepelin, 1913; Tikader & Bastawade, 1983; Kovařík, 2003; Bastawade *et al.*, 2012; Mohapatra *et al.*, 2022); Elsewhere: Bangladesh, Nepal.

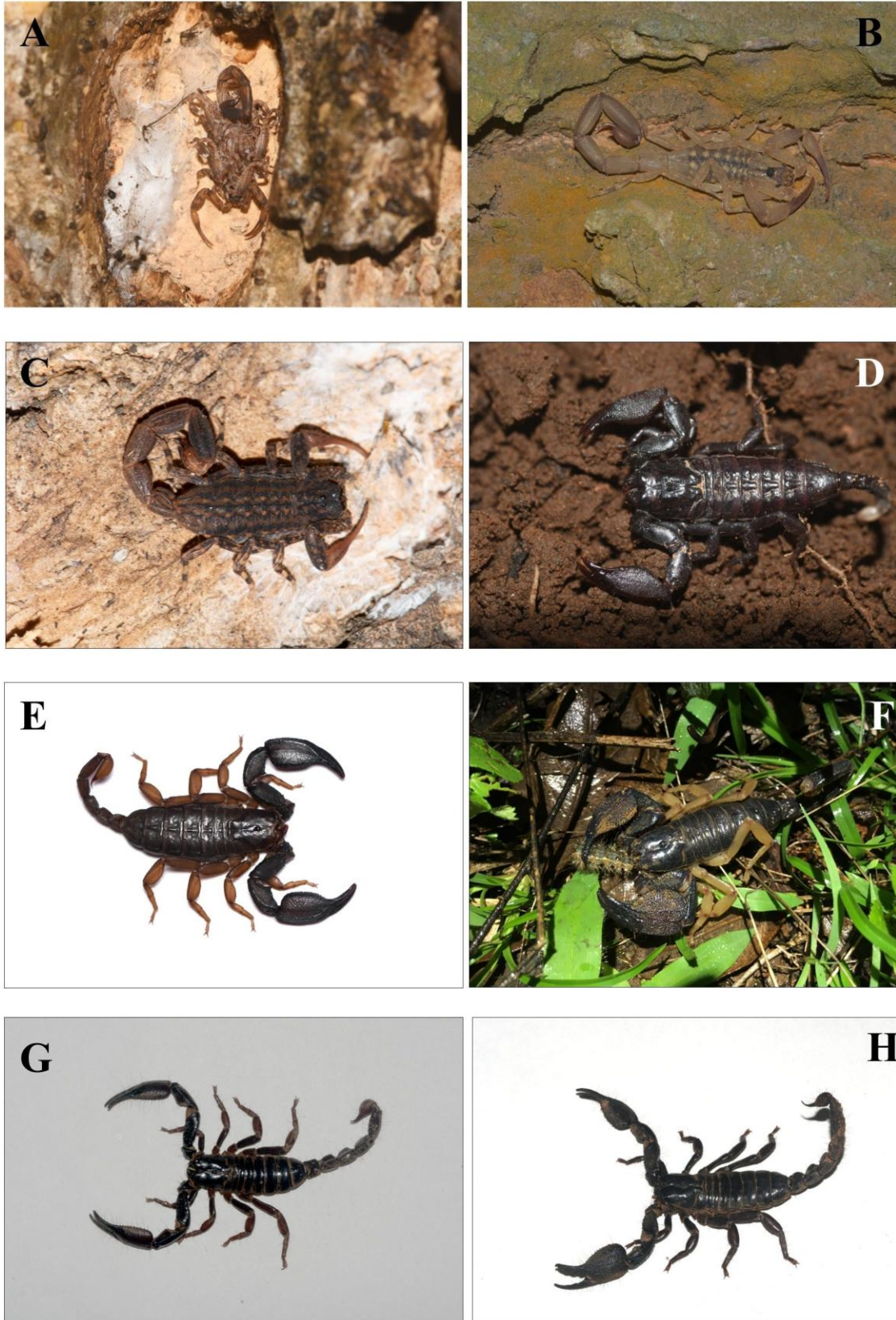


Fig. 7. Field photos: A. *Reddyanus assamensis*. B. *Lychas scaber*. C. *Reddyanus rigidulus*. D. *Liocheles nigripes*. E. *Scorpions pachmarhicus*. F. *Chersonesometrus fulvipes*. G. *Deccanometrus bengalensis*. H. *Gigantometrus swammerdami*.

14. *Reddyanus rigidulus* (Pocock 1897) (Fig. 7C)

Type locality: Madhya Pradesh: Bhopal.

Distribution: Madhya Pradesh, Maharashtra, Rajasthan, Odisha (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 2003; Bastawade *et al.*, 2012).

Family **Hormuridae** Laurie, 1896

Genus *Liocheles* Sundevall, 1833

15. *Liocheles nigripes* (Pocock, 1897) (Fig. 7D)

Type locality: Gujarat: Panch Mahal.

Distribution: Rajasthan, Madhya Pradesh, Odisha, Andhra Pradesh, Chhattisgarh, Gujarat, Uttarakhand, Uttar Pradesh, Telangana (Pocock, 1900; Tikader & Bastawade, 1983; Zambre & Patil, 2011; Bastawade *et al.*, 2012; Mirza, 2017; Mohapatra, 2021; Mohapatra *et al.*, 2022).

Family **Scorpionidae** Latreille, 1802

Genus *Chersonesometrus* Couzijn, 1978

16. *Chersonesometrus fulvipes* (C.L. Koch, 1837) (Fig. 7F)

Type locality: Maharashtra: Chandrapur Dist.

Distribution: Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, NCT Delhi, Odisha, Rajasthan, Uttar Pradesh, Telangana (Tikader & Bastawade, 1983; Kovařík, 2007; Bastawade *et al.*, 2012; Prendini & Loria, 2020; Mohapatra, 2021; Mohapatra *et al.*, 2022).

17. *Chersonesometrus madraspatensis* (Pocock, 1900)

Type locality: Andhra Pradesh: Kadapa Dist.

Distribution: Andhra Pradesh, Chhattisgarh, Karnataka, Odisha, Tamil Nadu, Pondicherry, Telangana (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 2004; Bastawade *et al.*, 2012; Mohapatra, 2021).

Genus *Deccanometrus* Prendini & Loria, 2020

18. *Deccanometrus bengalensis* (C.L. Koch, 1841) (Fig. 7G)

Type locality: West Bengal.

Distribution: Assam, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand, West Bengal (Kovařík, 2004; Lourenço *et al.*, 2005; Prendini & Loria, 2020; Mohapatra & Pandey, 2020); Elsewhere: Nepal, Tibet and China.

19. *D. liurus* (Pocock, 1897)

Type locality: Madhya Pradesh: Gwalior Dist.

Distribution: Madhya Pradesh (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 2004; Bastawade *et al.*, 2012; Prendini & Loria, 2020; Mohapatra *et al.*, 2022).

20. *Deccanometrus phipsoni* (Pocock, 1893)

Type locality: Madras: Shevroy Hills (Lectotype by Prendini & Loria, 2020).

Distribution: Andhra Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 2004; Bastawade *et al.*, 2012; Prendini & Loria, 2020; Mohapatra *et al.*, 2022).

Genus *Gigantometrus* Couzijn, 1978

21. *Gigantometrus swammerdami* (Simon, 1872) (Fig. 7H)

Type locality: India Orientalis.

Distribution: Andhra Pradesh, Chhattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh, Odisha, Tamil Nadu, Telangana, West Bengal, Pondicherry (Tikader & Bastawade, 1983; Kovařík, 2004; Prendini & Loria, 2020); Elsewhere: Sri Lanka.

Family **Scorpiopidae** Kraepelin, 1905

Genus *Scorpiops* Peters, 1861

22. *Scorpiops pachmarhicus* Bastawade, 1992 (Fig. 7E)

Type locality: Madhya Pradesh: Pachmarhi and near Dhoopgarh, Hoshangabad Dist.

Distribution: Madhya Pradesh (Bastawade, 1992; Kovařík, 2000; Bastawade *et al.*, 2012; Mirza & Gowande, 2016).

Discussion

Very few works have been undertaken on documenting the scorpion diversity of Central India, which are mostly limited to earlier works (Pocock, 1900; Tikader & Bastawade, 1983; Kovařík, 2007; Chandra *et al.*, 2010; Patil *et al.*, 2016 a, b; Pandey *et al.*, 2021). In the present study of the 22 species documented from the central India four species were found to be new records from Chhattisgarh for which a detailed morphometry was provided (Table 1). A few morphometric variations were observed in some of these species.

The scorpion fauna of Central India is more similar to the species distributed in Peninsular India than the species recorded from Semi-arid and Gangetic plains. Distribution of species like *Scorpiops pachmarhicus*, in the state shows that the pockets of wet zones are acting as refugee for the humid forest species of fauna and flora, which were once distributed in wider ranges (Abdulali 1949; Mani 1974). It is also a well-established fact that, many of the faunal and floral species including scorpions are disjunctly distributed, which resulted due to fragmentation of the wet zone during Pleistocene climatic fluctuations, by Late Miocene wet-zone contraction, or by more ancient events (Karanth, 2003). The wet-zone pockets in the hills are considered refuges providing stable habitat which has resisted the past climatic fluctuations that impacted the biotic evolution in the surrounding plains (Ponton *et al.*, 2012). The central India region acts as a bridge between the Himalayas and the Western Ghats and by supporting various ecosystems it holds a wonderful opportunity of finding new records as well as new species.

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Table 1. Morphometry of the new reports from Chhattisgarh (in mm).

| Characters / Regd. No. | A-21731 ♂ <i>H. jabalpurensis</i> | A-21334 ♀ <i>H. jabalpurensis</i> | A-22522 ♂ <i>L. scaber</i> | A-22525 ♂ <i>L. scaber</i> | A-21333 ♀ <i>L. biharensis</i> | A-21327 ♀ <i>B. politus</i> |
|---------------------------|--------------------------------------|--------------------------------------|-------------------------------|-------------------------------|-----------------------------------|--------------------------------|
| TL | 65.46 | 59.12 | 37.89 | 39.86 | 38.75 | 23.01 |
| CL | 7.61 | 6.71 | 4.23 | 4.48 | 4.37 | 2.89 |
| AW | 3.69 | 3.37 | 1.48 | 1.97 | 1.92 | 2.12 |
| MW | 6.43 | 6.07 | 3.26 | 3.38 | 3.32 | 2.75 |
| PW | 7.88 | 7.11 | 4.10 | 4.29 | 4.19 | 2.66 |
| ME to AC | 3.04 | 2.44 | 0.79 | 1.23 | 1.24 | 0.44 |
| ME to PC | 4.09 | 3.78 | 2.10 | 2.65 | 2.75 | 1.30 |
| 1 st LE to ME | 3.14 | 2.54 | 0.67 | 1.49 | 1.42 | 0.59 |
| MesL | 19.01 | 16.35 | 9.64 | 9.96 | 11.09 | 9.36 |
| MTL | 30.35 | 28.49 | 19.34 | 20.57 | 18.6 | 10.76 |
| Met-I-L | 4.67 | 4.41 | 3.07 | 3.09 | 2.73 | 1.71 |
| Met-I-W | 5.1 | 4.7 | 2.11 | 2.22 | 2.51 | 2.27 |
| Met-I-H | 3.81 | 3.56 | 1.92 | 1.86 | 2.09 | 1.66 |
| Met-II-L | 5.42 | 5.2 | 3.34 | 3.65 | 3.09 | 1.85 |
| Met-II-W | 4.81 | 4.5 | 1.86 | 1.92 | 2.42 | 2.26 |
| Met-II-H | 3.82 | 3.64 | 1.90 | 1.85 | 2.13 | 1.66 |
| Met-III-L | 5.65 | 5.36 | 3.66 | 3.98 | 3.30 | 2.11 |
| Met-III-W | 4.65 | 4.39 | 1.87 | 1.83 | 2.36 | 2.34 |
| Met-III-H | 3.81 | 3.57 | 1.85 | 1.89 | 2.14 | 1.69 |
| Met-IV-L | 6.64 | 6.15 | 4.27 | 4.21 | 4.19 | 2.24 |
| Met-IV-W | 4.39 | 3.98 | 1.76 | 1.71 | 2.23 | 2.33 |
| Met-IV-H | 3.78 | 3.7 | 1.84 | 1.81 | 2.08 | 1.71 |
| Met-V-L | 7.97 | 7.37 | 5.04 | 5.64 | 5.29 | 2.85 |
| Met-V-W | 4.35 | 3.98 | 1.63 | 1.64 | 2.05 | 2.31 |
| Met-V-H | 3.88 | 3.66 | 1.95 | 2.06 | 2.11 | 1.74 |
| TeL | 8.49 | 7.57 | 4.64 | 4.85 | 4.69 | 2.81 |
| TeW | 3.3 | 3.15 | 1.45 | 1.48 | 1.26 | 1.37 |
| TeH | 3.13 | 2.87 | 1.56 | 1.55 | 1.26 | 1.14 |
| VL | 5.25 | 4.72 | 3.04 | 3.23 | 2.81 | 2.10 |
| AL | 3.24 | 2.85 | 1.6 | 1.62 | 1.88 | 0.71 |
| PecL | 6.1 | 6.12 | 3.72 | 3.61 | 3.65 | 2.40 |
| PecW | 1.89 | 1.91 | 1.21 | 1.23 | 1.08 | 0.87 |
| PT-L/R | 30/30 | 31/31 | 20/20 | 19/20 | 23/23 | 17/16 |
| GOL | 1.53 | 1.03 | 0.77 | 0.74 | 0.72 | 0.56 |
| GOW | 2.03 | 1.63 | 1.12 | 1.09 | 1.04 | 0.86 |
| PedL | 24.77 | 22.56 | 14.34 | 16.99 | 14.61 | 8.35 |
| MnL | 3.83 | 4.33 | 2.49 | 2.64 | 2.18 | 1.32 |
| MnW | 2.18 | 2.4 | 1.51 | 1.26 | 1.22 | 0.68 |
| MnH | 2.24 | 2.4 | 1.40 | 1.32 | 1.26 | 0.65 |
| PatL | 7.23 | 6.55 | 3.93 | 4.81 | 4.48 | 2.70 |
| PatW | 2.7 | 2.5 | 1.44 | 1.21 | 1.35 | 0.79 |
| PatD | 1.94 | 1.85 | 1.57 | 0.77 | 1.23 | 0.60 |
| FeL | 6.07 | 5.65 | 3.88 | 4.36 | 3.83 | 1.93 |
| FeW | 2.09 | 2.01 | 1.04 | 1.21 | 1.07 | 0.68 |
| FeD | 1.7 | 1.55 | 0.84 | 0.77 | 0.93 | 0.56 |
| Ti/C-L | 11.47 | 10.36 | 6.53 (C) | 7.82 | 6.30 | 3.72 (C) |
| MFL | 8.11 | 6.85 | 4.64 | 5.19 | 4.40 | 2.61 |
| FFL | 8.25 | 6.88 | 5.22 | 5.16 | 3.98 | 3.12 |

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***Steatoda paykulliana* (Walckenaer, 1806) in Jordan (Araneae: Theridiidae)**

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Abstract

Steatoda paykulliana (Walckenaer, 1806) of family Theridiidae is recorded from Amman, Jordan for the first time. Only one adult female specimen of this species was collected in May 2024 inside a shop in Amman. Its illustrations and measurements are presented.

Keywords: Araneae, Theridiidae, *Steatoda paykulliana*, Jordan.

Introduction

Family Theridiidae Sundevall, 1833 is a big family of 2571 species in 129 genera and Genus *Steatoda* Sundevall, 1833 includes 116 species + 4 species in the World (World Spider Catalog, 2024).

Steatoda spiders are commonly known as "False black widows", but they are not dangerous or serious like black widow spiders.

Steatoda paykulliana (Walckenaer, 1806) or the Mediterranean false black widow spider is mainly distributed in the Mediterranean countries (southern European countries and North Africa) to Central Asia and India (World Spider Catalog, 2024). It is a "synanthropic" spider that lives in close association with people and gets benefit from their surroundings, especially insects, and their activities.

One adult female specimen *Steatoda paykulliana* was collected in May 2024 inside a famous confectionery shop in Amman, Jordan. Its identification was not difficult but the examination of the genitalia was necessary to be sure of the record.



1



2



3



4



5



6

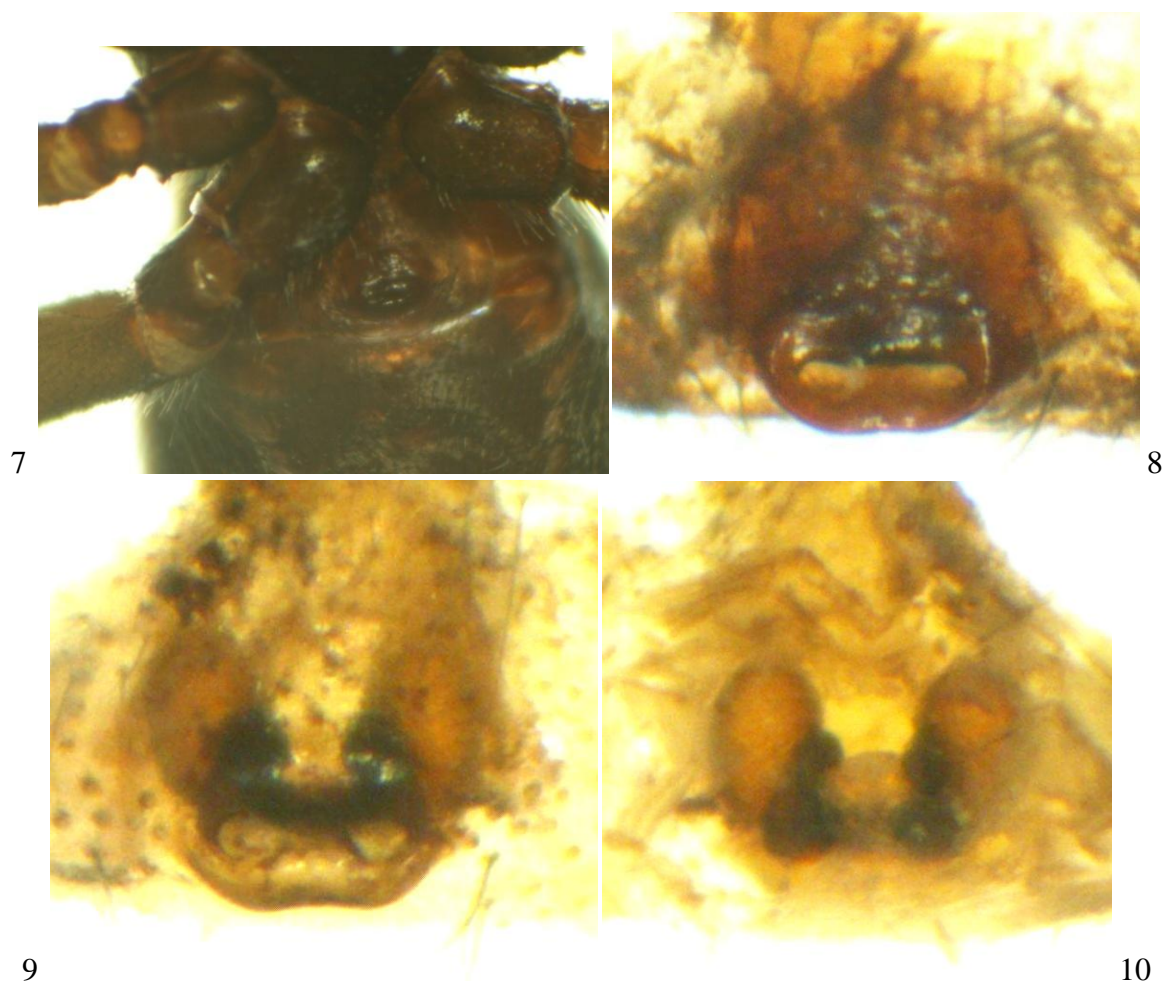
Figs. 1-6. *Steatoda paykulliana* (Walckenaer, 1806), ♀ from Amman, habitus (alive).
1-2. dorsal view. 3. latero-dorsal view. 4. ventral view. 5. cephalothorax, dorsal view.
6. abdomen, dorsal view.

Until now, theridiid spiders are represented in Jordan by only two species of the same genus, *i.e.*, *Latrodectus pallidus* O. Pickard-Cambridge, 1872 (El-Hennawy, 2006) and *Latrodectus tredecimguttatus* (Rossi, 1790) (El-Hennawy *et al.*, 2022) (El-Hennawy, 2023).

This record increases the confirmed number of known spider species from Jordan to 37 species of 31 genera and 17 Families.

Abbreviations used: ACE = Arachnid Collection of Egypt, AL = abdomen length, AW = abdomen width, CL = carapace length, CW = carapace width, TL = total length.

All measurements are in millimetres (mm).



Figs. 7-10. *Steatoda paykulliana* (Walckenaer, 1806), ♀ epigynum. 7. intact. 8. separated. 9-10. cleared. 9. ventral view. 10. dorsal view (vulva).

Family **Theridiidae** Sundevall, 1833

Genus *Steatoda* Sundevall, 1833

Steatoda paykulliana (Walckenaer, 1806)

Figs. 1-10.

Material examined. Jordan, 1♀, Amman (31°58'06.01"N, 35°52'38.53"E elev. 968 m), 6 May 2024, standing on a bench inside a confectioner's shop, leg. Samar Qumei [ACE.2024.05.06.AR.001.JOR].

For the description of *Steatoda paykulliana*, see Roberts (1995: 277) and for its synonyms see World Spider Catalog (2024).

Female habitus, cephalothorax, and abdomen (Figs. 1-6). (Note colouration.)

Measurements: ♀ TL 5.8, CL 2.5, CW 1.8 (thoracic region), AL 3.4, AW 2.2.

Table 1. Measurements of leg segments of *Steatoda paykulliana* (♀).

| Leg | Femur | Patella | Tibia | Metatarsus | Tarsus | Total |
|-----|-------|---------|-------|------------|--------|-------|
| I | 2.8 | 1.0 | 2.0 | 2.5 | 1.0 | 9.3 |
| II | 2.3 | 0.7 | 1.6 | 1.8 | 1.0 | 7.4 |
| III | 1.8 | 0.5 | 1.5 | 2.3 | 0.9 | 7.0 |
| IV | 2.8 | 1.0 | 2.0 | 2.1 | 1.0 | 8.9 |

Legs 1423

Female epigynum and vulva: see Figs. (7-10).

Acknowledgment

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